Chapter 2
Review of Literature

2.1 Epidemiology of LBP

LBP is a common health, economic and social problems in western countries. In the industrial countries. LBP is also a health problems that was frequent about 70% of the working population. LBP is an important part in the illnesses of the population. From insurance claims data showing that were offset by LBP up to 16 percent and accounted for 33% cost of all compensation (Webster & Snook, 1994). General population would have an experience of LBP more than once over the lifetime. A systematic review also found percentage 85 of recurrent LBP during the life (Andersson, 1999). The majority of western countries, LBP was associated with the cost of medical care, absent from work and lack of impotence in the works (van Tulder, et al., 1995). A study of the Occupational Health Division, Department of Health surveyed the musculoskeletal problems dued to industrial working in over 300 offices in 48 provinces throughout Thailand. They also interviewed the workers about pain and fatigues on the body parts from a total of 2,595 workers showed that 78.5 percent of the study population had pain and fatigues which LBP was most of 52.4% (Sengkisiri, 1998). From the replacement fund statistics from network compensation fund, Social Security Office of Thailand, 2006, found that among working population back and spinal problems around 7 % (5,390 persons from 204,257 persons) compared with other organs (*Social Security Statistics 2006: Statistics of Workmen's Compensation Fund (Covered by WCF)*, 2007). The study of Praneet, 2005 found that the cause of back pain often caused by injury from the work of 56.4% (Pensri, Foster, Srisuk, Baxter, & McDonough, 2005). Low bcak pain resulted in an inefficient working, also led to the charge ad time in care which affected families, social and economic status.

2.2 Low back pain definition

LBP basically refers to ache, pain or discomfort in a lumbar area whether or not it extended from there to one or both legs (Ozguler, Leclerc, Landre, Pietri-Taleb, & Niedhammer, 2000).

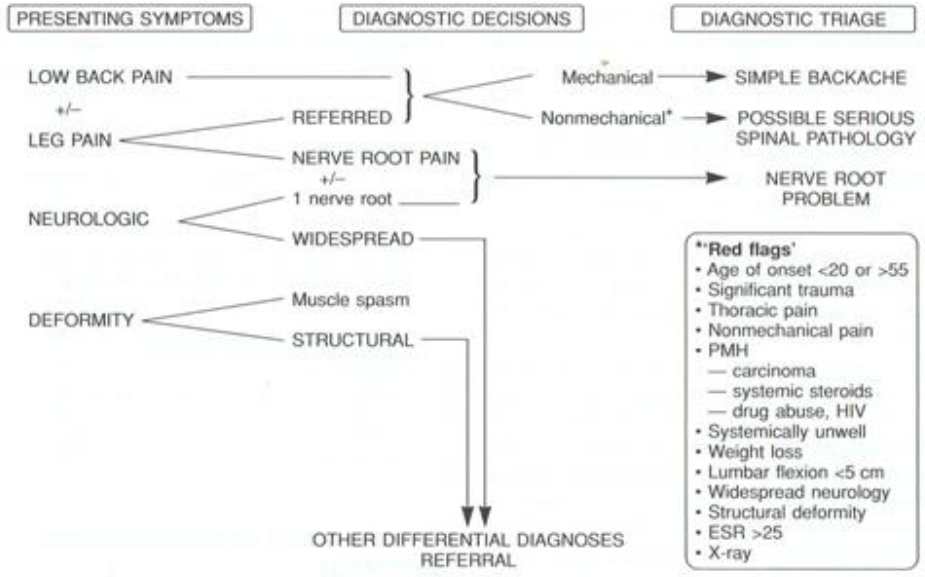

Figure 2.1 Differential diagnostic flow chart (Waddell, 1998)

The following can identify the cause of the symptoms. LBP caused by mechanical mechanisms, due to to internal organs and other causes (Jarvik & Deyo, 2002). It is difficult to identify the anatomical structure that is resourced of symptom. Figure 1 shows the differential diagnostic flow chart by Waddell (Waddell, 1998). Patients with low back disorders present with four key symptoms including simple back pain leg pain, neurological symptoms, and spinal deformity. More than 99% of LBP problems present with back pain and it is rare to see a low back problem with no back pain. Pain always tends to radiate distally and 70% of patients with back pain also have some pain in one or both legs. Neurological symptoms and spinal deformity are much less common but crucial to diagnosis. To differentiate theses four symptoms of low back problems, need to thoroughly history take and physical examination. Mechanical LBP have been believed that the strong strain in excess of the structure to force or strain resistant to normal levels

occur with unusual structures. Most of LBP (97%), typically causes symptoms including lumbar strain or sprain (70%), degenerative disc and facets (10%), Herniated disc (4%), spinal stenosis (3%), osteopathic compression fracture (4%), spondylolisthesis (2%), traumatic. fracture (<1%), congenital disease (<1%), spondylosis, and presumed instability (Jarvik & Deyo, 2002).

2.3 Risk factors of LBP

According to the biopsychosocial model theories determining risk factors that lead to musculoskeletal disease should consider three areas of individual, psychosocial and occupational factors (van Tulder, Koes, & Bombardier, 2002).

2.3.1 Individual factors

The individual factors that influence the incidence of LBP, including age, gender, body weight, exercise levels, history of past illness, smoking behavior, drinking alcohol, and strength of back and abdominal muscles (van Tulder, et al., 2002).

2.3.1.1 Age

The prevalence of LBP increases with age until adulthood and there is strong evidence that adult LBP originates in adolescence (Leboeuf-Yde & Kyvik, 1998). In the cohort used for the present study, the cumulative incidence of LBP was previously reported to increase considerably from 12 to 22 years with more than 50% of 20-year-olds having experienced LBP (Hestbaek, Korsholm, Leboeuf-Yde, & Kyvik, 2008).When getting older there is more physiological changes such as strength, durability and flexibility of the tissue decreased. Self-repairing process is slow rates lead to degenerative changes of various tissues. Hellsing in 2000 found that LBP at age 18, the time of military enlistment, significantly increased the risk of LBP at age 40 and 30 (Hellsing & Bryngelsson, 2000).

2.3.1.2 Gender

The low back pain is a problem of both female and male. Although studies have suggested that females are at risk will experience LBP than men (Croft, Macfarlane, Papageorgiou, Thomas, & Silman, 1998; Schneider, Randoll, & Buchner, 2006). In addition, research has indicated that women use health care for back pain, absence from work because of back pain and has residual back pain over 3 months than male (Thomas, Silman, & Croft, 1999).

2.3.1.3 Obesity

Obesity is one of several lifestyle factors that have been suspected of causing LBP. Body mass index is up more than 30 independently predict the occurrence of the LBP and impotence due to pain (Leboeuf-Yde, Kyvik, & Bruun, 1999). There is a lack of a clear dose-response relationship between body mass index (BMI) and LBP (Mirtz & Greene, 2005). From a literature review, found that due to lack of evidence, body weight should be considered a possible weak risk indicator, but there is insufficient data to assess if it is a true cause of LBP (Leboeuf-Yde, 2000). However, compared with non-overweight people, overweight people had a higher prevalence of LBP but a lower prevalence of LBP compared with obese people. In cohort studies, only obesity was associated with increased incidence of LBP for 1 day in the past 12 months (Shiri, Karppinen, Leino-Arjas, Solovieva, & Viikari-Juntura, 2010).

2.3.1.4 Physical activity

Physical activity is defined as any bodily movement produced by contraction of skeletal muscle that substantially increases energy expenditure (Danforth, Jensen, Kopelman, Lefebvre, & Reeder, 2001). While physical fitness is defined as a set of attributes (i.e., cardiorespiratory endurance, skeletal muscle endurance, skeletal muscle strength, etc.) that relate to the ability to perform physical activity (Danforth, et al., 2001). There is increasing evidence that physical activity is related to the development

and course of LBP, but the relationships of causality, directions, strength, and modifying factors are only partially known (Vuori, 2001). Low physical fitness has also been suggested as a risk factor for LBP; however, evidence is weak because of contradictory results in the literature (Takala & Viikari-Juntura, 2000; Thomas, et al., 1999). Moreover, a review study suggested that implementation of worksite physical activity programs could increase the level of physical activity and reduce the risk of musculoskeletal disorders (Proper, et al., 2003).

2.3.1.5 Smoking behavior

Smoking is a risk factor to the LBP. Smoking affects directly to the bones and muscles. Smoking increases the risks of bone fracture and cause some bone mass reduction and cause degeneration of the spinal bone. Power (Power, Frank, Hertzman, Schierhout, & Li, 2001) found that the higher prevalence of LBP among smokers than non-smoker. The research found that smoking more than 15 consecutive years is associated with sciatic pain (Miranda, Viikari-Juntura, Martikainen, Takala, & Riihimaki, 2002), but found that no amount of smoking as a contributing factor (Leboeuf-Yde, Kyvik, & Bruun, 1998). Moreover, among smokers having a job with heavy lifting and much standing was a predictor of LBP four years follow-up (Eriksen, Natvig, & Bruusgaard, 1999). Whereas Motimer (Mortimer, Wiktorin, Pernold, Svensson, & Vingard, 2001) found that smoking did not influence the risk of LBP. So it is not clear evidence to confirm the relationship between smoking groups with a LBP.

2.3.1.6 Drinking alcohol

Alcohol consumption does not seem to be associated with LBP, but well-designed specific alcohol LBP studies are lacking (Leboeuf-Yde, 2000). It is possible to review the literature study is largely a cross sectional study and found no studies in the prospective study.

2.3.1.7 Trunk muscle performances

Trunk muscle performance means strength, durability and balance of back muscle and abdominal muscles, which act as a shock absorber and promotes the movement of the primary spinal anatomy. Trunk muscles play an important role in force protection attacks on spinal structures. Anatomical study found that trunk muscle serves to strengthen the spine structure (Jorgensen, 1997). Trunk muscle strength is a physical ability that influences musculoskeletal treatment and rehabilitation. Physical performance and the response to work can affect LBP especially if there was imbalance between the physical performance and work. Trunk muscle performances are important personal factors that affect treatment and rehabilitation of patients with LBP. Research found that the recommended exercise program to increase strength and stability of the spine was one of effective treatment (Burton, et al., 2005; Soukup, Glomsrod, Lonn, Bo, & Larsen, 1999; Soukup, Lonn, Glomsrod, Bo, & Larsen, 2001; Underwood, 2000; van Poppel, Hooftman, & Koes, 2004). In addition the exercise was not only to recover of functional of trunk muscle and also to prevent the symptoms of LBP (Gundewall, Liljeqvist, & Hansson, 1993; Soukup, et al., 2001).

However, there were scientific evidence arguments that strength of the trunk muscles causing LBP or not. Kujala in 1996 surveyed LBP by a self-report questionnaire, results found that no significant difference in trunk muscle strength and endurance among participants with and without LBP in 5-year follow-up period (Kujala, et al., 1996). In contrast to research in 2008 found that low trunk muscle endurance was a risk of LBP (Stroyer & Jensen, 2008). Masset in 1998 (Masset, et al., 1998) found the relationship between the incidence of lower back pain and trunk rotation and lateral flexion more than trunk flexion and extension. Lee in 1999 (Lee, et al., 1999) found extension/ flexion ratio in the volunteer group with self-reported LBP was less than the group without LBP. The imbalance between trunk flexor and extensor muscle may affect the LBP. The evaluation of trunk muscle by using Isokinetic Biodex ^{TM} Sytem-3 in wrestling athletes found that 53 cases with self- reported LBP associated with peak torque at test speed 120, 60 and 90 degrees per second (Iwai, et al., 2004).

Systematic review of the Hamberg-van Reenen in 2007 (Hamberg-van Reenen, et al., 2007) found that had not been concluded the relationship between trunk muscle strength and LBP. The major reason was difference in methodology to evaluate trunk muscle strength and spinal mobility such as by isometric muscle strength test (Adams, et al., 1999; Alaranta, et al., 1995), isokinetic muscle strength test (Lee, et al., 1999; Masset, et al., 1998; Takala & Viikari-Juntura, 2000) and dynamic functional test (Rissanen, et al., 2002; Stevenson, et al., 2001), main outcome was only self-reported LBP (Adams, et al., 1999; Barnekow-Bergkvist, et al., 1998; Josephson, et al., 1996; Kujala, et al., 1996; Masset, et al., 1998; Rissanen, et al., 2002; Takala & Viikari-Juntura, 2000). Moreover, the definition of LBP was also different.

The stability of the spine was composed of co-ordination among of anatomical 3 structure system that consists of spinal vertebrae, trunk muscles, and nervous system (Panjabi, 2003). A research reported that co-ordination between the transversus abdominis and multifidus muscles is important role for spinal stability (Hodges & Richardson, 1996; Storheim, et al., 2002). Due to these two muscles increases tension in thoracolumbar fascia which acts as a shield to increase stability of lumbar spine. A study showed that transversus abdominis muscle would work slower in patients with LBP (Hodges & Richardson, 1996). However, the effect of transversus abdominis and the multifidus muscles on LBP have not found in the prospective study.

2.3.2 Occupational factors

From a systematic review of 42 epidemiological research about the musculoskeletal work injury (Bernard, 1997) found that LBP occurred more frequently in the general population. There had 70% life-time prevalence in industrial countries. More than 40 researches discussed the relationship of LBP and 5 work characteristics including lifting and high physical loading work, bending and twisting work, work with whole body vibration, repetitive work, and work in static posture. There was strong evidence showed the association between LBP and lifting and high physical loading work and work with whole body vibration.

2.3.3 Psychosocial factors

A study about depression in people who never had serious back pain history showed that after 6 months follow-up those reporting LBP was in a group of depressed conditions only 1 % (Mannion, Dolan, & Adams, 1996). This suggests that social psychological factors that can explain the patient response to LBP but can not explain the initial onset of pain. Consistent with the study found stress from work was associated with chronic LBP (Kopec & Sayre, 2004). Whereas a health survey report in 1,638 people who had never LBP revealed that depression and anxiety could be predictors for 16% incidence of LBP (Cairns, Foster, & Wright, 2006). Moreover, a review study reported that stress, worry and anxiety were risk factors to predict incidence of LBP (Linton, 2000).

2.4 Tools and outcome measurements

LBP could be evaluated by historytaking, physical examination and questionnaire. If necessary may evaluate in complex methodology such as x-ray, MRI, CT scan and blood test, etc. However, the differentiation of the structure that is the source of symptom was exactly difficult. The diagnosis of LBP in adult populations were often considered symptoms that are associated with systematic diseases or neurological impairment or a psychosomatic problem due to suffering mental stress for a long time (Deyo, et al., 1998).

2.4.1 History taking

History taking have to do extremely thorough. Important questions to ask including mechanism of symptoms, symptoms, position of symptoms, duration of the pain, pain characteristics, the neurological symptoms such as loss of sensation, behavior such events affect symptoms, history of underlying illness, surgical history, past history of injury and characteristics daily living (Rives & Douglass, 2004). After that all of the history should be combined with physical examination and lead to accurate diagnosis (Waddell, 1998).

2.4.2 Physical examination

Good physical examination for lumbar spine including observation / inspection muscles, skin, alignment of the spine, standing posture, walking posture and sitting posture. Palpation on bony prominent and muscles is another part of examination. Measurement spinal range of motion including flexion, extension and lateral flexion direction. Moreover, sensory examination and nerve tension test such as Straight leg raising test (SLR test) were necessary to confirm the structure the course symptoms which lead to accurate diagnosis (Deyo, et al., 1998).

2.4.3 Habitual physical activity questionnaire

Measurement of physical activity is often found to be important in research about health. The accuracy in assessing energy expenditure by both direct and indirect calorimetric techniques is good, but these laboratory techniques are not applicable to large scale epidemiological studies. There are various methods for measuring physical activity in epidemiological studies. The questionnaire is one of the tools for measuring habitual physical activity. A questionnaire was developed and used for measuring habitual activity in term of the usual time spends in various types of activity (Baecke, et al., 1982). There was 16 items concerning three components; work index, sport index and leisure time activities index excluding sport. All responses were proceeding on five-point scales with the exception of the questions on the name of main occupation and type of sport played. The level of habitual physical activity was calculated from the score of the three indices of physical activity and could categorized into 3 levels; sedentary (score below 6), active (score between 6-8) and athletic level (score above 8).

2.4.4 Functional disability questionnaire for LBP

The Oswestry disability index (ODI) was created in 1976 by using the information from patients with chronic back pain that referred to a specialist clinic and has developed into a version 2.0 (Fairbank, Couper, Davies, & O'Brien, 1980). ODI was

used widely since its respond easily. The modified ODI was used conjunction with the North American Spine Society Questionnaire (NASS) to evaluate LBP disability (Daltroy, Cats-Baril, Katz, Fossel, & Liang, 1996). ODI is a questionnaire that was most often used in validity test (Bombardier, 2000; Deyo, et al., 1998; Leclaire, Blier, Fortin, & Proulx, 1997) found that the reliability and internal validity was well acceptable. The ODI is sensitive to patient with symptom changed than patients with stable symptoms that mean ODI may have a floor effect. For the external validity, many researches compare the ODI with other questionnaire which showed that the ODI has both advantages and disadvantage (Davidson & Keating, 2002; Leclaire, et al., 1997). However, there were validity tests of ODI in several languages including English, French, German, Finnish and Greek, including Thai. Thai modified ODI was allowed to make cross-cultural translation and legally testing by Sakulsriprasert in 2006 (Sakulsriprasert, Vachalathiti, Vongsirinavarat, & Kantasorn, 2006). Moreover, Thai ODI has been found good criterion validity (Sanjaroensuttikul, 2007).

2.4.5 Trunk muscle performance evaluation

2.4.5.1 Isokinetic device

The accurately and precisely assessment of muscle performance is an important part in research. The muscle functional assessment varies according to the type of muscle work including static muscle contraction and dynamic muscle contraction. The Isokinetic muscle contraction was developed by Jame Perrine in 1967 (Perrin, 1993) from the principle of exercise that can control constant speed and resistance to modify by the ability of the muscle during each movement. So muscle can exert over a full range of movement. Isokinetic measurement could report muscle performance in quantitative values including torque, work and power. The isokinetic measurement has been widely used in physical therapy research and was accepted to be a highly accurate and reliable measure for trunk muscle performance evaluation (Karatas, Gogus, & Meray, 2002; Keller, Johansen, Hellesnes, & Brox, 1999).

2.4.5.2 Sorensen test

Beiring-Sorensen developed method of endurance testing to back muscle called the Sorensen test used to assess clinical tolerance of back muscles. In those with LBP tested reliability (Arab, Salavati, Ebrahimi, & Ebrahim Mousavi, 2007; Latimer, Maher, Refshauge, & Colaco, 1999; Moreau, Green, Johnson, & Moreau, 2001) and high validity (Coorevits, Danneels, Cambier, Ramon, & Vanderstraeten, 2008). Moreover, Sorensen test also be used in research studies association between endurance of back muscle and the risk of LBP. A research found that the low endurance of the back muscles could be a risk factor to the LBP (Adams, et al., 1999; Alaranta, et al., 1995). Stroyer in 2008 (Stroyer & Jensen, 2008) followed 327 employees who exercise in a 3-year period found that those with a moderate endurance (107-157 seconds) measured from the modified Sorensen test has a risk of LBP (OR = 2.7, 95% CI 1.08-6.79) compared with the high endurance group (158-360 seconds). However, some studies found no relationship between the back muscles endurance and LBP (Stewart, Latimer, & Jamieson, 2003). Anyway, the Sorensen test is still recognized as a clinical reliable method to evaluated patients with LBP (Denis, Shannon, Wessel, Stratford, & Weller, 2007).

2.4.5.3 Spinal stability test

STABILIZER™ pressure biofeedback device was developed by physiotherapist. Using the principles of measuring air pressure in air bags while the movement of trunk. This tool was used in the assessment and rehabilitation (Mills, Taunton, & Mills, 2005 1506; Thongjunjua, 2007 1505). STABILIZER ™ pressure biofeedback could inform the co-contraction between transversus abdominis muscle and multifidus which is the core muscles to help increase stability of the lumbar spine.

2.5 Target population

Thammasat University is a large University in government sector that consisting of more than 5,000 staff. From the statistic in Annual Report 2007, Thammasat

University, last update in February 2006 (*Annual Report Thammasat University 2007*, 2007) can be classified as follows;

1. By gender	Number
Male	1,907
Female	3,746
Total	5,653
2. By type of personnel	
The government officials and employees	2,703
University employees	967
Special employee statements	172
Employees within the agency and employee income	1,822
Total	5,664
3. By Division line	
Academic	1,453
Supportive 1	1,133
Supportive 2	1,940
Permanent employee	1,127
Total	5,653

Interesting that working in different positions has the possibility to cause the LBP which will affect the operations of the organization.