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Epidemiology

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1. Introduction

Low back pain (LBP) is a common problem that most people experience at some point in their lifetime. It is reported that the ranges of prevalence of LBP at a point, 1-year and over lifetime were from 4.4% to 33%, from 3.9% to 65% and from 11% to 84%, respectively (Andersson, 1999; Loney et al., 1999; Louw et al., 2007; McBeth et al., 2007; Walker, 2000). The differences of prevalence ranges can be caused by variation in areas, age, lifestyle, social situations and study methodology. In addition, the economic burden of LBP is very heavy (Brooks, 2006; Dagenais et al., 2008). It is, therefore, important for LBP patients to understand LBP and how to prevent LPB.

LBP is a symptom of a pain which can be localised between the twelfth rib and the inferior gluteal folds (low back), with or without leg pain from various causes (Krismer & van Tulder, 2007), but is not a disease. LBP is generally classified as 'specific' or 'non-specific'. Non-specific LBP is defined as symptoms of unknown origin or without identifiable pathology, and specific LBP is defined as that caused by a specific pathophysiological mechanism, such as disc prolapse or herniated nucleus pulposus, infection, inflammatory arthopathy, turmour, osteoporosis or fracture (van Tulder & Waddell, 2005). Most cases are non-specific, but in 5%-10% of cases a specific cause is identified (Krismer & van Tulder, 2007). Though the causes of LBP are varied, these may be classified as spondylogenic, neurogenic, viscerogenic, vascular and psychogenic (Wong & Transfeldt, 2007). These causes can be attributed to non-specific and/or specific factors, and these factors combine with each other in some cases. Moreover, it is necessary to ascertain the factors causing LBP and whether it is primary or secondary LBP. We are able to treat and prevent LBP promptly when we specify the causes of LBP, though most of pathomechanism of LBP is unknown (Nachemson, 1992).

2. Epidemiology of LBP

LBP is an important health problem in both developed and developing countries (Brooks, 2006; Woolf & Pfleger 2003). LBP results in socio-economic losses, health and clinical problems, not only for individuals but also for countries, because LBP causes obstacles to work or work absence and increases economic burden of treatment and compensation. Therefore, epidemiological study holds an important position in understanding LBP.

Epidemiology is the study of the health of human populations. Its functions are:

1. To discover the agent, host, and environmental factors which affect health, in order to provide the scientific basis for the prevention of disease and injury, and the promotion of health.
2. To determine the relative importance of causes of illness, disability, and death, in order to establish priorities for research and action.
3. To identify those sections of the population which have the greatest risk from specific causes of ill health, in order that the indicated action may be directed appropriately.
4. To evaluate the effectiveness of health programs and services in improving the health of the population. (Brownson, 1998).

In the case of LBP, epidemiology investigates the various factors of LBP included in the risk factors for LBP, the effects of prevention measures and interventions on LBP, the interaction of risk factors for LBP, time course changes of LBP, the burden of LBP, associations among this information and so on. Much epidemiological research on LBP has been conducted worldwide. This research is important in understanding the past, present and future of LBP, and epidemiological data provide much information to assist in seeking and solving the various problems related to LBP. Moreover, these data can prevent LBP by avoiding or decreasing risk factors for individuals.

The two most basic concepts of epidemiology are incidence and prevalence. Incidence is defined as the rate at which healthy people develop a new symptom or disease over a specified period of time. In contrast to incident, prevalence is a measure of the number of people in the population who have a symptom or disease at a particular point in time (Manchikanti, 2000). Therefore, it is necessary to note the methodological problems in the study of the epidemiology of LBP.

2.1 Prevalence of LBP in the general population

LBP is more common between the ages of 25 and 64 years (World health organization [WHO], 2001), though it can occur in all age ranges. The prevalence of LBP peaks between ages 35 and 55 (Andersson, 1992). This is considered to reflect the work force and high prevalence in the age between 30 and 50 is reported (European Foundation for the Improvement of Living and Working Conditions [Eurofound], 2007; Japan Industrial Safety & Health Association [JISHA], 1994). The prevalence of LBP has been investigated in many surveys, with point, annual, and lifetime prevalence generally showing that prevalence is widespread among the investigations. This indicates the variety of investigations, especially the methodology such as population (age, gender, race, number and lifestyle), region, time, period, definition of LBP and contents of questionnaires in the investigation. However, the preventive measures for LBP that are suited for regional populations can be found through the epidemiological data.

Cunningham and Kelsey reported that back trouble is a frequent problem and the prevalence of back pain symptoms is estimated to be 17.2% from the data source of The United States (US) Health and Nutrition Examination Survey, 1971-1975 (HANES I) of the US adults aged 25-74 years (Cunningham & Kelsey, 1984). Strine and Hootman reported that from National Health Interview Survey in 2002 the prevalence of LBP increase with aging and the total prevalence of LBP only was 17.0% and the prevalence of both neck and LBP was 9.3% of US adults aged 18 years and over (Strine & Hootman, 2007). In addition,

the prevalence of chronic LBP increased from 3.9% in 1992 to 10.2% in 2006 in North Carolina households in those aged21 years and older (Freburger et al., 2009). Cassidy et al. estimated the point and lifetime prevalence of LBP were 28.4% and 84.1% in Canadian aged from 20 to 69 years (Cassidy et al., 1998). In the United Kingdom (UK), Badley and Tennant reported the prevalence of back pain was 10.0% with the prevalence increasing with aging and the highest prevalence was shown in the aged 56-64 years from the survey of Calderdale population aged 16 years and older (Badley & Tennant, 1992). Hillman et al. reported the point and lifetime prevalence of LBP were 19% and 59%, respectively, in the Bradford population aged 25 years and over (Hillman et al., 1996). Ihlebaek et al. reported the prevalence of LBP in Norway and Sweden (Ihlebaek et al., 2006). They showed the point and lifetime prevalence of LBP were 9.9% and 62.4% in men and 16.8% and 59.1% in women in Norway, and 14.6% and 68.9% in men and 20.4% and 69.9% in women in Sweden, respectively (Ihlebaek et al., 2006). In Finland, about one-third of people aged over 30 years experienced back pain during the past month in the early 2000s. Clinical diagnosed back syndrome decreased from 17.6% to 10.4% in men and from 16.5% to 10.6% in women aged over 30 years in 1978-1980 and 2000-2001 (Heliovaara & Riihimaki, 2006).

The prevalence of LBP has been investigated in some systematic reviews. Andersson reported that the lifetime prevalence of back pain as over 70% and 1-year prevalence ranges from 15% to 45%, with point prevalence averaging 30% (Andersson, 1999). Hoy et al. estimated that point and 1-year prevalence of LBP ranged from 1.0% to 58.1%, with a mean of 18.1%, and ranged from 0.8% to 82.5% with a mean of 38.1%, respectively, in their systematic review (Hoy et al., 2010). They estimated the prevalence of LBP to be very widespread. Loney et al. reviewed 18 studies that were conducted 7 countries in Europe, North America and China (Loney & Stratford, 1999). They estimated the average point and 1-year prevalence were 19.2% (ranged from 4.4% to 33.0%) and 32.37% (ranged from 3.9% to 63%), respectively. In high quality studies (over 70 points methodologically), point and 1-year prevalence ranged from 13.7% to 28.7% and from 39% to 44.9%, respectively (Loney & Stratford, 1999). McBeth et al. found that point and lifetime prevalence of LBP ranged from 13% to 30% and from 51% to 84%, respectively, in the investigation using 13 selected studies (McBeth & Jones, 2007). Walker selected 30 studies of 56 studies using methodological examination (75% pass level for methodological acceptable) and reported that point prevalence ranged from 12% to 33%, 1-year prevalence ranged from 22% to 65% and lifetime prevalence ranged from 11% to 84% (Walker, 2000). Louw et al. estimated point, 1-year, and lifetime prevalence of LBP in 27 eligible studies in African countries (Louw et al., 2007). Studies in this review were conducted in 10 countries and they selected 10 South Africa studies, 7 Nigerian, 2 Tunisian and 8 from other countries. They estimated that point prevalence ranged from 16% to 59%, averaging 32% among adults in 9 methodologically sound studies, and 1-year prevalence ranged from 14% to 72%, averaging 50% among adults in 9 studies, and lifetime prevalence ranged from 28% to 74%, averaging 64% among adults in 6 studies. Point, 1-year, and lifetime prevalence of LBP potentially increased with age (Louw et al., 2007). In the study by Volinn in 1995 (Volinn, 1995), it was reported that LBP rates in high-income countries were higher than those in low-income countries. LBP rates among the selected for the high-income countries (Belgium, Germany and Sweden) were approximately twice or even higher than the low-income countries (Nepal, India, Nigeria, China, Indonesia and Philippines), especially in rural areas. Point prevalence of LBP ranged from 29% to 42% in the high-income countries and ranged from 7% to 18% in rural areas in

the low-income countries, though point prevalence of LBP was 14% in Britain (Volinn, 1995). In the study by walker (Walker, 2000), the highest point and lifetime prevalence of LBP in developing nations were 16.5% and 50% in Yugoslavia, respectively, excluding unclear information, and the highest point and lifetime prevalence of LBP in other nations were 33% in Germany and Belgium, and 79% in New Zealand, respectively. However, prevalence of LBP in Africa is similar to that of Western countries (Louw et al., 2007). Moreover, Hestbaek et al. reviewed 36 studies (28 observational studies and 8 randomized controlled trials) and reported that point prevalence of LBP in persons with one or more previous episodes of LBP ranged from 14% to 93%, and those without a prior history of LBP ranged from 7% to 39% in 6 studies (Hestbaek et al., 2003). Hillman et al. reported that the annual incidence of LBP was 4.7% (Hillman et al., 1996) and Cassidy et al. reported the cumulative incidence of LBP was 18.6% (Cassidy et al., 2005). Hoy et al. estimated the 1 year incidence of a first-ever episode of LBP ranged from 6.3% to 15.4%, and the 1-year incidence of any episodes of LBP ranged from 1.5% to 36% (Hoy et al., 2010). Manchikanti reported the prevalence of recurrent or chronic LBP at 3, 6 and 12 months to range from 35% to 79% (Manchikanti, 2000).

Study	Studies of number	Range of prevalence (%)		
		Point	Period	Lifetime
Andersson, 1999	12	12.0 - 30.2	25 - 42	51.4 - 69.9
Hestbaek et al., 2003	6	14 - 93		
Hoy et al., 2010	19	1.0 - 58.1	0.8 - 82.5	
Loney et al., 1999	18	4.4 - 33.0	3.9 - 63	13.8 - 84
Louw et al., 2007	27	16 - 59	14 - 72	28 - 74
McBeth, 2007	13	13 - 30	31 - 67	51 – 84
Volinn, 1995	8 (high income countries)	14 - 42		
	6 (low income countries)	7 - 28		
Walker, 2000	30	12 - 33	22 - 65	11 - 84

Table 1. Point, period and lifetime prevalence of LBP in the general population

Point and lifetime prevalence of LBP is estimated to be 6.8% and 13.8%-17.2% in the US, 4.4%-28.7% and 84% in Canada, 14%-19% and 58%-59% in the UK, 19%-33% and 59% in Belgium, 13.7% and 62%-64% in Denmark, and 12%-31% and 31%-70% in Sweden, respectively, according to the systematic reviews (Hoy et al., 2010; Loney et al., 1999; McBeth, 2007; Walker, 2000). The prevalence of LBP decreased from 33% in 2000 to 24.7% in 2005 in Europe (Paoli & Merllie, 2001; Parent-Thirion et al., 2007). Prevalence rates of LBP are difficult to compare because of the time of sampling, the sampling technique and the actual questions asked (Andersson, 1999). Therefore, it is important to know the time-trend of LBP.

2.2 Occupational LBP

In LBP, occupational LBP has been a topic for research for a long time. Occupational LBP is an important problem for workers and nations, and various remedies have been proposed. Occupational LBP will be work-specific when considering the factors causing LBP. Since occupational LBP is caused by work-related factors, which are physical factors (e.g. heavy

physical work, manual handling, lifting, bending or twisting, vibration, awkward postures, repetitive work) and psychosocial factors (e.g. work environment, job content, job dissatisfaction, social support, personal relation) (Pope et al., 1991; Andersson, 1992; Burdorf & Sorock, 1997), it can occur in various types of work settings. Therefore, occupational LBP is not only an individual medical problem, but also a social economic problem.

Musculoskeletal disorders (MSDs) are widespread in many countries and they are the single largest category of work-related illness (Punnett & Wegman, 2004). MSDs account for over 50% of occupational diseases in Europe (Eurofound, 2007), and LBP and neck pain are equally a high prevalence in MSDs. The World health organization (WHO) treats occupational and work-related disease separately, and occupational LBP is included in work-related disease (WHO, 2001). WHO defines that occupational diseases are adverse health conditions in a human being, the occurrence or severity of which is related to exposure to factors on the job or in the work environment, and reports that such factors can be physical, chemical, biological, ergonomic, psychosocial stressors and mechanical. WHO characterizes work-related diseases as multifactorial diseases which may frequently be work-related and when such diseases affect the worker they may be work-related in a number of ways: they may be partially caused by adverse working conditions; they may be aggravated, accelerated or exacerbated by workplace exposures; and they may impair working capacity (WHO, 2001). Additionally, Schilling proposed the categories of adverse environmental agents as workplace hazards and the categories of work-related disease and injury as the concept of work-related disorders which has broadened to include those categories with more understanding of the multiple causes of disease (Schilling, 1989). Occupational LBP can occur related to these workplace hazards and under the categories of work-related disorders.

Occupational LBP can be defined as the back pain caused by work-induced and related factors. Generally, physical, psychosocial and personal factors interact with the onset of occupational LBP. In Japan, Aoyama proposed occupational LBP (Aoyama, 1984) as:

1. LBP occurring after working for the first time though there is no incidence of LBP before working, or LBP becoming worse after working even if there is onset of LBP before working,
2. a high prevalence of LBP is seen at the same place of work and the same type of job,
3. LPB improved by measures taken in the place of work, such as improvement of working conditions and environment, absence and reshuffling of personnel.

Also, occupational LBP is defined as work-specific LBP and classified as accidental and non-accidental LBP under regulations related to workmen's compensation (Ministry of Labour, 1976). The former is injury that results from an unexpected event triggering injury during the task, and injuries of muscle, tendon, ligament and soft tissue (strains or ruptures) in the back are found. The latter, where pain arises as a result of normal activities and requirements of the task, and poor body mechanics, prolonged activity, repetitive motions, and fatigue are major contributors to injuries.

It is, however, difficult to determine the relationship between occupational or work-related factors and LBP because:

1. LBP is not easily defined,
2. sickness absence data are influenced not only by pain, but also by physical and psychologic work factors, social factors and the insurance system,

3. the healthy worker effect may bias data,
4. exposure is difficult to determine, and
5. there is poor relationship between tissue injury and disability (Pope et al., 1991).

In Europe, definitions of work-related MSDs are different between countries and there are some nations that lack any definitions of work-related MSDs, nevertheless, the social security institutions in these countries do provide a list of occupational diseases that entitle workers reporting such conditions to compensation (Eurofound, 2007). It is proposed that occupational LBP not be dealt with via compensation or suits, but via prevention and prevention of recurrence through work-related factors, because occupational LBP has become the major cause of work absence causing damage not only to an individual with occupational LBP and his family, but also to a country (Kurihara, 1994). Therefore, it is very important to take measures related to occupational LBP and its recurrence.

2.2.1 Prevalence of occupational LBP

Much epidemiological research on LBP has been conducted worldwide. This research is important to understand the past, present and future of LBP, and in obtaining epidemiological data providing much information in helping to seek and solve various problems of LBP. LBP is more common between the ages of 25 and 64 years (WHO 2001). The lifetime prevalence of back pain is reported as over 70% in industrialised countries, and 1-year prevalence varies between 15% and 45% (Andersson, 1999). The incidence of back pain has been reported to be approximately 5% per year (Hoogendoorn, 1999).

In Europe, MSDs represent more than 50% of serious work-related diseases, with a prevalence rate of over 2.5% among employees (more than 4 million employees), (Eurofound, 2007), and 1 in every 4 workers cites problems with backache (Parent-Thirion et al., 2007). However, prevalence of LBP decreased from 33% in 2000 to 24.7% in 2005 in Europe (Paoli & Merllie, 2001; Parent-Thirion et al., 2007). The trend of backache as a musculoskeletal disorder shows an increase in Spain and stability in the Netherlands and Norway (Eurofound, 2007). In the Netherlands, 12-month period prevalence of low back problems was 44.4% in men and 48.2% in women of the working population; about 12% of them had activity limitation (Picavet et al., 1999) and LBP was the most frequent musculoskeletal pain (point prevalence is 26.9%), (Picavet & Schouten, 2003). In UK, 40% of adults reported back pain in the previous 12 months and 15% of adults suffered from back pain throughout the year. 5% of working people with back pain had taken time off work (Department Health, 1999). In the US, about 2% of the US workers were compensated for back injuries each year (Andersson, 1999). The prevalence of back pain in working people was 17.6% in 1988 (Guo et al., 1995). Ghaffari et al. reported that 1-year prevalence was 20% in men and 27% in women, and 1-year incidence of disabling LBP was 2.1% in Iranian industrial workers (Ghaffari et al., 2006a, 2006b). Guo et al. reported that 1-year prevalence was 18.3% in men and 19.7% in women in workers in Taiwan (Guo et al., 2004). It is estimated that 2%-5% of industrial workers experience LBP each year (WHO 2001). Acute low back pain is usually considered to be self-limiting and 90% of LBP recover within 6 weeks, but 2%-7% of people develop chronic pain (The COST B13 Working Group, 2004b). After an initial episode of LBP, 44%-78% people suffer relapses of pain occur 26%-37%, relapses of work absence (The COST B13 Working Group, 2004a). Therefore, it is considered that many people suffered from chronic LBP and this affected individual and social-economic activities. There is little scientific evidence on the prevalence of chronic non-

specific back pain: best estimates suggest that the prevalence is approximately 23%; 11%-12% of population are disabled by LBP (The COST B13 Working Group, 2004a). Recurrent and chronic back pain is widely acknowledged to account for a substantial proportion of total worker absenteeism. About half of days lost due to absenteeism are accounted for by the 85% of people away from work for short periods (<7 days), whilst the other half is accounted for by the 15% who are off work for >1 month; this is reflected in the social costs of back pain, where some 80% of the health care and social costs are for the 10% with chronic pain and disability (The COST B13 Working Group, 2004b).

Occupational LBP can occur in all workers in all types of job, though the prevalence varies according to the type of job. Generally, agricultural workers, construction workers, drivers, mine workers and nursing aids show high prevalence (Behrens et al., 1994; Guo et al., 1995; JISHA, 1994; Parent-Thirion et al., 2007), and the variety of prevalence by job type is considered to depend on the kinds, frequency, time, duration and intensity of occupational exposure. It is considered that many causes of LBP exist in work with a high prevalence of LBP. Table 2 shows the reported backache by sector and gender (Eurofound, 2007).

	A	B	C	D	E	F	G	H	I	J	K	L	total
Men	43.8	28.0	24.7	39.2	21.0	20.0	31.4	9.7	16.6	19.7	19.6	21.1	27.0
Women	54.4	31.2	17.2	17.7	18.7	24.9	17.5	14.6	16.7	19.7	22.4	21.2	23.6
Total	47.0	29.0	23.3	37.0	19.8	22.2	27.9	11.9	16.6	19.7	21.7	21.2	25.6

A: Agriculture and fishing, B: Manufacturing and minig, C: Electricity, gas and water supply,
D: Construction, E: Wholesale and retail trade, F: Hotels and restaurants,
G: Transport and communication, H: Financial intermediation, I: Real estate and business servise,
J: Public administration, K: Education and health, L: Other service.

Table 2. Reported backache by sector and gender (Eurofound, 2007)

It is reported that the ranges of a point or annual prevalence of LBP were from 27% to 75% for farmers (Kumudini & Hasegawa, 2009; Liu et al., 2011; Milosavljevic et al., 2011; O'Sullivan et al., 2009; Taechasubamorn et al., 2011), from 44% to 74% for drivers (Alperovitch-Najenson , 2010; Bovenzi, 2009; Rozali et al., 2009), from 32% to 78% for mine workers (Bio et al., 2007; Sarikaya et al., 2007), from 20% to 23% for construction workers (Inaba et al., 2007, 2009), from 46% to 83% for care workers (Jensen et al., 2009; Minematsu, 2007; Sorensen et al., 2011; Yalcinkaya et al., 2010) in recent studies. Guo et al. reported the highest risk of back pain was among construction workers (22.6%) for men and among nursing aides (18.8%) for women (Guo et al., 1995). It is considered that the prevalence of LBP is highest in workers exposed to many occupational risk factors.

2.2.2 Onset of accidental LBP

Prevalence and incidence of occupational LBP are different according to age, gender, type of job, nations and methods of investigation. High physical and high psychosocial exposures increase the risk of symptoms of back disorder (Devereux et al., 1999). It is considered that long working time or experience increases the risk of LBP because occupational exposure time and occupational impact have a negative effect. It is reported that prevalence of back pain in full-time workers is 25.3% compared with 19.1% in part-time workers, and the prevalence of back pain is more than 23% among workers who worked over 36 hours weekly and more than 38% among workers who worked over 45 hours weekly (Eurofound, 2007). In a study of LBP

among drivers, an uncomfortable working station (Alperovitch-Najenson, 2010), long career (Szeto & Lam, 2007), high daily vibration exposure (Bovenzi, 2010), annual driving mileage (Porter & Gyi, 2002) and long daily driving time, and cumulative total hours of exposure (Tiemessen et al., 2008) tended to increase the prevalence of back troubles. Moreover, the prevalence of LBP is significantly higher in those currently or previously exposed to manual material handling and/or tiring postures (20%) compared with those never exposed to these strains (11%) in men below the retirement aged 45-59 (Plouvier et al, 2011). Walsh et al. reported that the incident of LBP was 64.5% in men and 61.4% in women, and the rates of sudden and gradual onset LBP were 32.0% in men and 26.3% in women, and 31.5% in men and 33.0% in women, respectively (Walsh et al., 1989). According to their study, the onset of LBP is similar between sudden and gradual in men, but gradual onset of LBP was higher by 7 points than the sudden onset in women. These factors can help to predict the risk of LBP and the prevention of LBP. However, there are few reports that investigate when LBP is likely to occur. As stated above, occupational LBP is separated into accidental LBP and non-accidental LBP. Since the cause of accidental LBP is clear, accidental LBP is certified as liable for worker accident compensation in many cases, as compared with non-accidental LBP.

At present conditions of the onset of accidental LBP in Japan are mentioned based on the report of a preventive measure of LBP by JISHA (JISHA, 1994) and Kuwashima, et al. (Kuwashima et al., 1997). Accidental LBP has been about 6,000 cases per 1 year, according for more than half of all occupational diseases. The survey studied 13,166 cases that were diagnosed as accidental LBP requiring an absence of 4 days or more. In the results, the number of cases per 10,000 working population is 1.5 for male (85.5%) and 0.4 for female (14.5%), respectively. The number of case per 10,000 of the working population by age-specific groups (under 19 years, every 5 years from 20 to 64 years and over 65 years) is from 1.0 to 1.3 from the age of 25 to 59 years and from 0.2 to 0.9 of the remaining age-specific groups, respectively. The onset rate of accidental LBP was about 90% from the age of 25 to 64 years. The onset of accidental LBP is the highest in July (9.1%, 1,203 cases) and the lowest in December (5.8%, 763 cases), but it is found in every month throughout the year (Figure1). Accidental LBP does not tend to occur frequently in winter season. The onset of accidental LBP by day occurs most on Mondays (20.3%) followed by Tuesdays (16.6%) (Figure 2), therefore, accidental LBP tends to occur frequently at the beginning of the week. Also, the onset rates of accidental LBP by time distinction are 11.2%, 16.6% and 14.9% from 8:01 to 9:00, from 9:01 to 10:00 and from 10:01 to 11:00, respectively (Figure 3). The onset of accidental LBP occurs most often in the morning, the rate being 43.1% between 8:00 and 11:00. Moreover, the onset of accidental LBP is more frequent in non-manufacturers (54.7%) than in manufacturers (31.7%). Specifically, traffic and transportation (22.6%), construction (14.5%), and commerce, finance and advertising (10.4%) in the non-manufacturing account for more than 10% of the onset of accidental LBP, on the other hand, mining (13.9) and cargo handling (12.3) account for more than 10 in the number of case per 10,000 of the working population. The accumulated percentage of cases of LBP by duration of employment shows about half are among those employed for less than 5 years.

It is considered that prevention measures for occupational LBP by type of job have many common parts, as the onset of accidental LBP is similar to prevalence of occupational LBP by type of job in other countries. However, as the incidence of occupational LBP in day and time might be different among countries because of life and working style, it is necessary to take prevention measures in the case of frequent occurrence of occupational LBP.

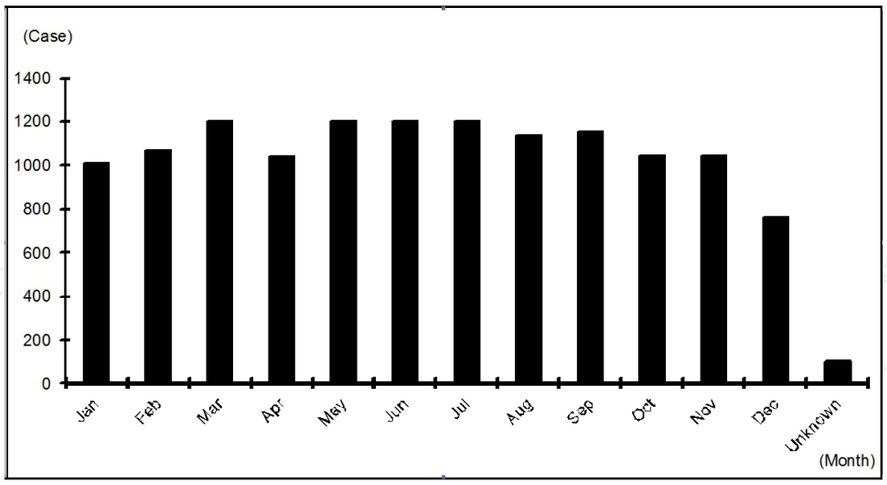

Fig. 1. Onset of LBP by months (JISHA, 1994)

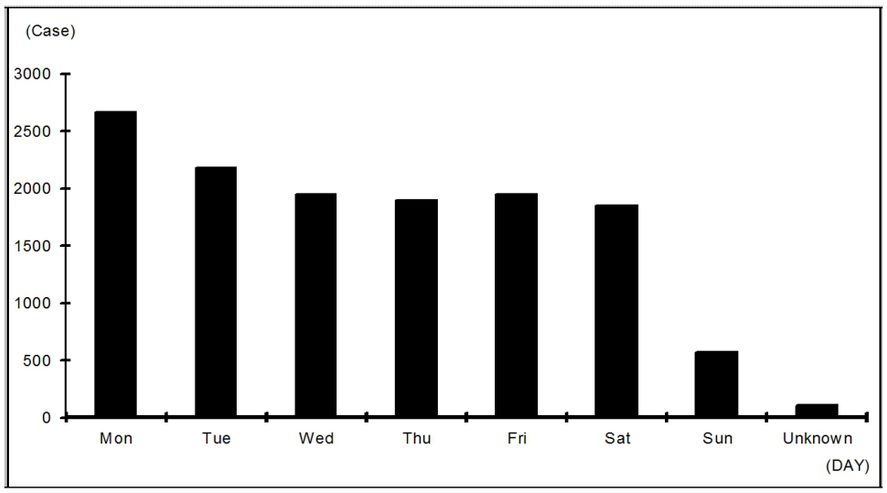

Fig. 2. Onset of LBP by days (JISHA, 1994)

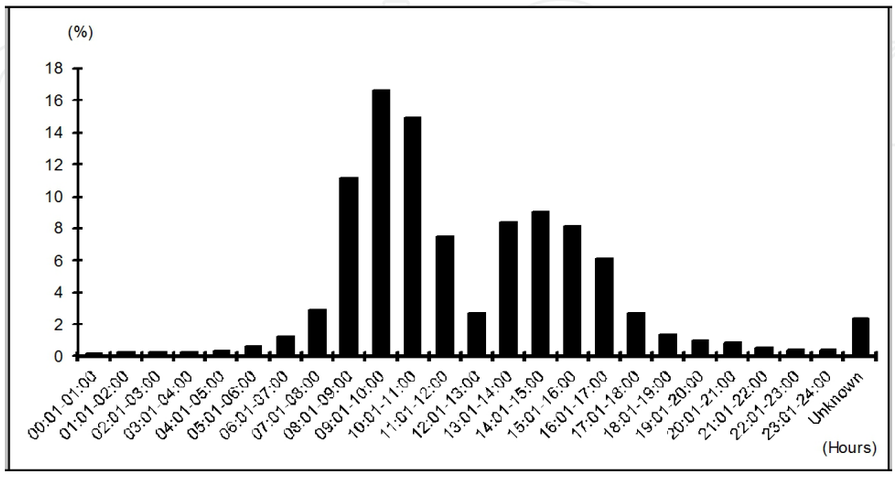

Fig. 3. Onset of LBP by hours (JISHA, 1994)

2.3 Risk factors of occupational LBP

Work-related risk factors in LBP are complex. Physical, psychosocial and personal factors interact in various ways to cause occupational LBP, although the degree of associated with the onset of occupational LBP is different. Namely, these factors have an effect on the incidence of occupational LBP and there is association among these factors (Fig. 4). The influence of these risk factors on LBP are reported, but the results are various.

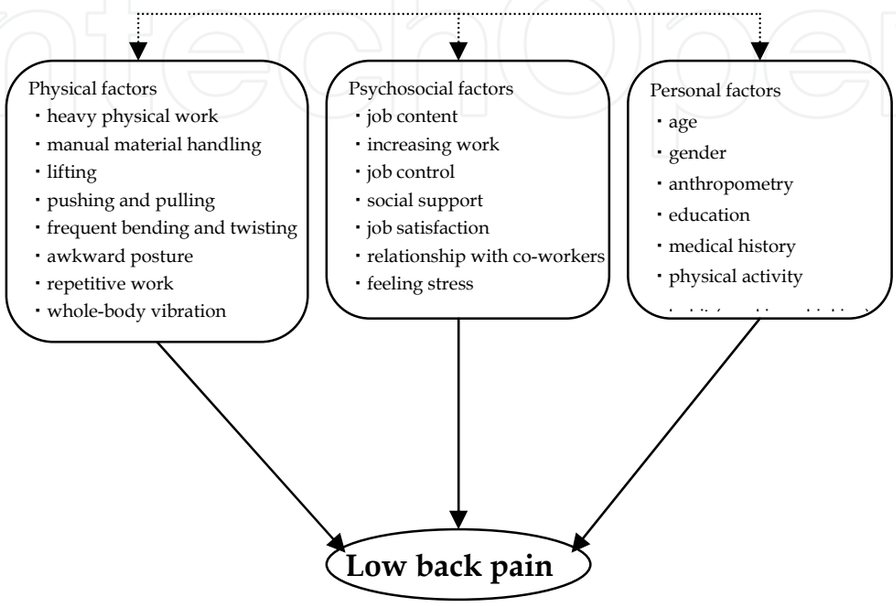

Fig. 4. The relationship of incidence of LBP with physical, psychological and personal factors

Burdorf and Sorock investigated the positive and negative evidence of risk factors for back disorders (Burdorf & Sorock, 1997). They selected 35 studies and estimated the risk of back disorders. Risk estimates of manual material handling, frequent bending and twisting, heavy physical load, static work posture, repetitive movements, and whole-body vibrations for positive associations in physical risk factors at work ranged from 1.12 to 3.07, from 1.29 to 8.09, from 1.54 to 3.71, from 1.30 to 3.29, 1.97, and from 1.47 to 9.00, respectively, and risk estimates of mental stress, job dissatisfaction, work pace, and monotonous work for positive associations in psychological risk factors at work ranged from 1.30 to 2.08, from 1.39 to 2.40, 1.21, and from 1.25 to 2.34, respectively (Burdorf & Sorock, 1997). Thorbjornsson et al., investigated the psychosocial and physical risk factors associated with LBP for over 24 years from 1969 to 1993 (Thorbjornsson et al., 1998). In this study, the prevalence of LBP was 24% among men and 34% among women in 1969, and the cumulative incidence of LBP from 1970 to 1992 were 43% and 38% among men and women, respectively. The prevalence of LBP over the past 12 months in 1993 was 39% among men and 44% among women (Thorbjornsson et al., 1998). Moreover, the highest associations between work related factors and LBP (prevalence ratio adjusted for age) was high physical load (1.4) among men and monotonous work (1.6) among women in 1969, full time work (2.1) among men and high mental load (1.4) among women in 1970-1992, and monotonous work (1.5) among men and poor social support (1.2) among women in 1993, respectively (Thorbjornsson et al., 1998).

These trends of LBP may be caused by the change of the exposure to risk factors and the difference of work by gender.

2.3.1 Physical factors

Physical factors include heavy physical work, manual material handling, lifting, pushing and pulling, frequent bending and twisting, awkward posture, repetitive work, and whole-body vibration (WBV). The one of the causes of LBP by physical factors is the load to disc and back muscles. Disc pressure and muscle activities are changed by posture and way a load is lifted. Fig. 5 and 6 are the figures indicating the change in disc pressure by posture and exercise (Nachemson, 1976).

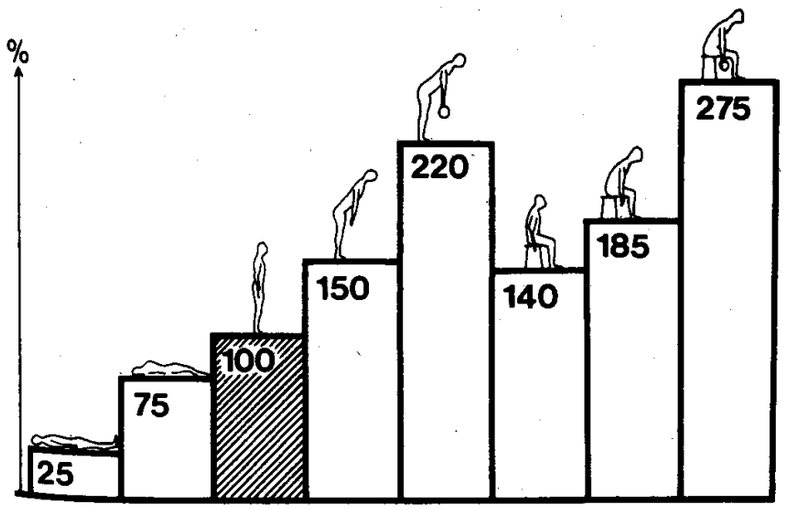

Fig. 5. Relative change in pressure (or load) in the third lumber disc in various positions in living subjects (Nachemson, 1976)

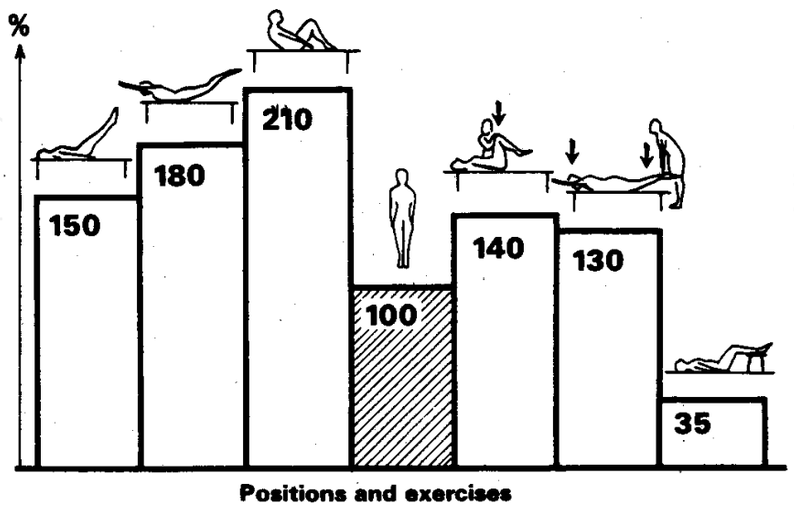

Fig. 6. Relative change in pressure (or load) in the third lumber disc in various muscle-strengthening exercise in living subjects (Nachemson, 1976)

Heavy physical work has been defined as work that has high energy demands or requires some measure of physical strength (Bernard et al., 1997a). The investigation of Bernard et al. provided evidence that low-back disorders are associated with heavy physical work (Bernard et al., 1997a). They selected 18 studies, and odds ratio (OR) and relative risk (RR) in the studies that indicated statistical significance showed the range of 1.2 to 12.1 and 2.2 to 4.3, respectively (Bernard et al., 1997a). Roffey et al. undertook a systematic review of the association of occupational pushing or pulling and workplace manual handling or patient assisting, and LBP (Roffey et al., 2010d, 2010e). Thirteen studies (12,793 participants, 7 countries) that reported a total of 83 estimates of the association between specific categories of occupational pushing or pulling and specific types of LBP outcomes enrolled. The mean prevalence of LBP was 38.1%. Sixteen (19%) were found to be statistically significant and 10 (52%) of which were classified as weak, 4 (24%) were classified as moderate, and 2 (10%) were classified as protective. An equal number of statistically significant estimates were reported in high-quality (50%) versus low-quality studies (50%). They concluded that occupational pushing or pulling does not appear to be independently causative of LBP in workers. There was conflicting evidence for association, though 4 out of 6 high-quality studies did not show any association and only one study with statistically significant weak association indicated a dose-response trend (Roffey et al., 2010d). Additionally, 32 studies (22,143 participants, 16 countries) that reported a total of 329 estimates of the association between specific categories of workplace manual handling or assisting patients, and specific types of LBP outcomes were enrolled (Roffey et al., 2010e). The mean prevalence of LBP was 39.2%. 72 (22%) were reported as statistically significant and of these 72 were statistically significant estimates of association, 49 (68%) were classified as weak, 17 (24%) were classified as moderate, 4 (5%) were classified as strong and 2 (3%) were classified as protective. A difference was noted in the proportion of estimates considered statistically significant from high-quality (38%) versus low-quality studies (62%). They concluded that specific categories of patient assisting could contribute to LBP because of the presence of a combination of strong and conflicting evidence, and assisting patients to ambulate could possibly be associated with disabling types of LBP in the nursing occupation (Roffey et al., 2010e).

Lifting is defined as moving or bringing something from a lower level to a higher one. The concept encompasses stresses resulting from work done in transferring objects from one plane to another, as well as the efforts of varying techniques of patient handling and transfer (Bernard et al., 1997a). Manual materials handling includes lifting, moving, carrying and holding loads. Forceful movements include movement of objects in other ways, such as pulling, pushing, or other efforts (Bernard et al., 1997a). Bernard et al. examined the relationship between back disorders and lifting or forceful movement in 18 studies, and there is strong evidence that low-back disorders are associated with work-related lifting or forceful movement (Bernard et al., 1997a). OR and RR in the studies that indicated statistical significance showed the range of 1.3 to 10.7 and 1.2 to 4.5, respectively (Bernard et al., 1997a). Wai et al. carried out a systematic review of the association of occupational lifting and carrying, and LBP (Wai et al., 2010b, 2010c). Thirty-five studies (88,864 participants, 16 countries) that assessed lifting reported a total of 224 separate estimates of the association between specific categories of occupational lifting and specific type of LBP outcomes were enrolled. The mean prevalence of LBP was 37.2%. 107 (48%) were reported to be statistically significant, and of these 107 statistically significant estimates of association, 33 (31%) were

classified as weak, 30 (28%) were classified as moderate, 38 (36%) were classified as strong and6 (5%) were classified as protective. There was noticeable difference in the proportion of estimates considered statistically significant in high-quality (18%) compared with low-quality studies (79%). They concluded that there was some moderate evidence for the association for specific types of lifting and LBP, and some evidence for the association between lifting greater than 25-35kg and LBP (Wai et al., 2010b). Twenty-two studies (27,785 participants, 10 countries) that reported a total of 109 separate risk estimates of the association between specific categories of occupational carrying and specific type of LBP outcomes were enrolled. The mean prevalence of LBP was 33.6%. Twenty-six (24%) were reported to be statistically significant, and of these 26, 15 (58%) were classified as weak, 8 (31%) were classified as moderate and 3 (12%) were classified as strong. There was the marked difference in the proportion of estimates considered statistically significant for high-quality (2%) compared with low-quality studies (35%). They concluded that there was strong and consistent evidence against both an association and temporal relationship between carrying and LBP, and there was no independent causal relationship between carrying and LBP (Wai et al., 2010c).

Bending is defined as flexion of the trunk, usually in the forward or lateral direction. Twisting refers to trunk rotation or torsion. Awkward postures include non-neutral trunk postures (related to bending and twisting) in extreme positions or at extreme angles (Bernard et al., 1997a). Bernard et al. selected 12 studies and investigated the relationship between back disorders and bending, twisting and awkward postures. The evidence of association with low-back disorders and awkward postures was shown (Bernard et al., 1997a). Results were consistent in showing increased risk of back disorder with exposure, despite the fact that studies defined disorders and assessed exposures in many ways. OR in the studies that indicated statistical significance showed the range of 1.2 to 8.1 (Bernard et al., 1997a). In a systematic review of the association of occupational bending or twisting and LBP by Wai et al., 35 studies (44,342 participants, 15 countries) that reported a total of 243 estimates of the association between specific categories of bending or twisting and specific types of LBP outcomes were enrolled. The mean prevalence of LBP was 38.7%. 107 (44%) were reported as statistically significant, and of these 107 statistically significant estimates of association, 61 (57%) were classified as weak, 20 (19%) were classified as moderate and 26 (24%) were classified as strong. No difference was noted in the proportion of estimates considered as statistically significant for high-quality (30%) versus low-quality studies (32%). They concluded that occupational bending or twisting is unlikely to be independently causative of LBP in workers and the strength of association was often rated as weak or moderate, additionally none demonstrated a statistically significant dose response (Wai et al., 2010a).

Static work postures include isometric positions where very little movement occurs, along with cramped or inactive postures that cause static loading on the muscles. These included prolonged standing or sitting and sedentary work. In many cases, the exposure was defined subjectively and/or in combination with other work-related risk factors (Bernard et al., 1997a). Bernard et al. selected 10 studies and resulted that the evidence of association with back disorders and static postures was inadequate though it is not easy to estimate the strength of association for some reasons (Bernard et al., 1997a). OR and RR showed in the studies that indicated statistical significance the range of 1.3 to 24.6 and 1.7 to 2.4,

respectively (Bernard et al., 1997a). Roffey et al. carried out a systematic review of the association of 3 factors, awkward occupational postures, occupational sitting, and occupational standing or walking, and LBP (Roffey et al., 2010a, 2010b, 2010c). Twenty seven studies (69,980 participants, 14 countries) that reported a total of 111 estimates of the association between specific categories of awkward occupational postures and specific types of LBP outcomes were enrolled. The mean prevalence of LBP was 47.8%. Fifty-three (48%) were reported as statistically significant, and of these 53 statistically significant estimates of association, 35 (66%) were classified as weak, 9 (17%) were classified as moderate, 4 (7%) were classified as strong and 3 (6%) were classified as protective. There was a difference noted in the proportion of estimates considered statistically significant for high-quality (35%) versus low-quality studies (57%). They concluded that awkward occupational postures do not appear to be independently causative of LBP in workers, and the strength of association was rated as weak, and only one study demonstrated a trend toward a nonstatistically significant dose response. They added that awkward postures could have an association with severe types of LBP in certain working populations, but causal relationship with LBP seems unlikely because of the conflicting or lack of strong evidence identified for the association from their results (Roffey et al., 2010a). Twenty-four studies (75,103 participants, 12 countries) that reported a total of 108 separate estimates of the association between specific categories of occupational sitting and specific types of LBP outcomes were enrolled. The mean prevalence of LBP was 42.2%. Seventeen (16%) were reported to be statistically significant and of these 17 statistically significant estimates, 3 (18%) were classified as weak and 14 (82%) were classified as protective. There was a marked difference in the proportion of estimates considered statistically significant for high-quality (0%) versus low-quality studies (100%). They concluded that occupational sitting does not appear to be independently causative of LBP in workers and the strength of evidence suggesting no association was consistent and rated as strong, with only one study demonstrating a trend toward a nonstatistically significant dose response (Roffey et al., 2010b). Eighteen studies (31,810 participants, 10 countries) that reported a total of 84 estimates of the association between specific categories of occupational standing or walking and specific types of LBP outcomes were enrolled. The mean prevalence of LBP was 43.2%. 21 (25%) were reported to be statistically significant and of these 21 statistically significant estimates, 11 (52%) were classified as weak, 5 (24%) were classified as moderate and 2 (10%) were classified as protective. A difference was noted between the numbers of statistically significant estimates that came from high-quality (19%) versus low-quality studies (81%). They concluded that occupational standing or walking is unlikely to be independently causative of LBP in workers, but if a causal relationship between occupational standing and LBP were to exist, it would likely to be a very weak one and only likely in specific sub categories (Roffey et al., 2010c).

WBV refers to mechanical energy oscillations which are transferred to the body as a whole (in contrast to specific body regions), usually through a supporting system such as a seat or platform. Typical exposures include driving automobiles and trucks, and operating industrial vehicles (Bernard et al., 1997a). Nineteen studies were selected and there is strong evidence of the positive association between exposure to WBV and back disorder though 4 of 19 studies demonstrated no association. OR and RR in the studies that indicated statistical significance showed the range of 1.2 to 39.5 and 1.7, respectively (Bernard et al., 1997). Lis et al. reported that occupational groups exposed to WBV while sitting are at an increased risk

of having LBP (OR is over 1.7), and the influence of the duration of the exposure seems more important than the magnitude of the exposure in cumulative effect, though sitting by itself did not increase the association with the present LBP (Lis et al., 2007).

2.3.2 Psychosocial factors

Psychosocial factors are defined as factors influencing health, health services and community well-being stemming from the psychology of the individual and the structure and function of social groups. They include social characteristics such as patterns of interaction within family or occupational groups, cultural characteristics such as traditional ways of solving conflicts, and psychological characteristics such as attitudes, beliefs and personality factors (WHO, 2001). Bongers et al. showed 5 categories of factors that may be associated with musculoskeletal symptoms:

1. psychosocial factors at work - demands and control (monotonous work, time pressure, high concentration, high responsibilities, high work load, few opportunities to take breaks, lack of clarity, and low control and little autonomy),
2. psychosocial factors at work - social support (poor social support from colleagues and poor social support from superiors),
3. individual characteristics (personality type, type A behaviour, extrovert personality, psychological dysfunctioning, coping style, attitude towards own health, low social class and low educational level),
4. stress symptoms (worry, tension, anxiety, physical stress symptoms, fatigue or exhaustion, high perceived work stress, low job satisfaction, and physiological parameters), and
5. physical and behavioural health indicators (poor physician health, respiratory disease or cough, stomach trouble, cardiovascular disease, headache, use of mediation and use of medical service), (Bongers et al., 1993).

Bernerd et al. investigated the association of psychosocial factors with back disorder (Bernard et al., 1997b). 4 of 5 studies that included measures of intensified work load found significant associations between back disorders and perceptions of intensified work load as measured by indices of both perceived time pressure and work load (OR 1.2-2.9). 5 of 7 studies that assess job dissatisfaction also found positive associations with back disorders. One study examined the relationship between social support and back disorders and found only weak evidence for an association.

In a systematic review by Hoogendoorn et al. including 11 cohort and 2 case-control studies, strong evidence was found for low social support in the workplace and low job satisfaction as risk factors for back pain (Hoogendoorn et al., 2000). Also, in the cohort study of 861 workers in Hoogendoorn et al., cumulative incidence of LBP during 3 years follow-up period was 26.6% (Hoogendoorn et al., 2001). The strongest relationships with LBP were found for high quantitative job demands, low supervisory support and low co-worker support (RR 1.3-1.6). However, most of the relationships were not statistically significant. They concluded that low co-worker and supervisory support appeared to be risk factors of LBP.

In a systematic review by Bongers et al. the associations between self-reported work demands (particularly monotonous work), poor social support at work, personality traits and emotional problems, and stress symptoms, and back trouble were reported (Bongers et al., 1993).

It is considered that low job satisfaction and low social support are associated with LBP, but it is unclear as to the associations between psychosocial factors and LBP. Davis and Heaney hypothesized as to the mechanisms of the relationship between psychosocial factors and LBP. First, psychosocial factors are directly related to LBP by influencing the loading on the spine via changes in trunk kinetics, the forces exerted or muscle activity. Second, psychosocial factors influence various chemical reactions in the body that take place during the performance of job tasks. Third, psychosocial factors influence the reporting of an injury by altering tolerance to pain (Davis & Heaney, 2000). They concluded that job satisfaction and job stress (workers reaction to psychosocial work characteristics) are more consistently and more strongly associated with LBP than are psychosocial work characteristics themselves and stated that not only the relationship between job satisfaction and LBP, but also the relationship between physical and psychosocial work characteristics and job satisfaction are needed to investigate in research (Davis & Heaney, 2000).

2.3.3 Personal factors

The common personal factors are age, gender, anthropometry, posture, muscle strength, muscle imbalances, spine mobility, education, medical history, physical fitness, habit (e.g. smoking) and socioeconomic conditions.

Most people experienced their first episode of back pain before 35yeras (Guo et al., 1995). In a European study, a prevalence of 18% was found before 25 years and 24% at 55 years and older (Parent-Thirion et al., 2007). The prevalence is relatively consistent during their working years (Guo et al., 1995). Generally, age and years of work are correlated, as the length of duration of work increases with advancing age. Moreover, the longer the years of work the greater the occupational exposure, additionally the likelihood of disc degeneration and herniation increases with aging. In a systematic review by Burdorf and Sorock, 12 studies reported positive association between age and back disorders, and 15 studies demonstrated no associations out of 30 studies (Burdorf & Sorock, 1997). Though pregnancy (Mogren, 2005) and osteoporotic fractures (Rostom, 2011) which are characteristic of women are causes of LBP, these are not work-related factors. Of course, LBP caused by these factors could possibly lead to leaving work and absence. The prevalence of back pain is equal among men (27%) and women (22%), (Parent-Thirion, 2007), though it is reported that prevalence of LBP is higher in girls than in boys at school age (Jones & Macfarlane, 2009; Mohseni-Bandpei et al., 2007; Watson et al., 2002; Yao et al., 2011). The attributable proportion of occupational LBP was higher for men than women (Punnett, 2005), and the results are very widespread. Occurrence of LBP by gender is considered to be related to differing participation in the various occupations.

It is reported that associations between anthropometry (sitting and standing height, weight, body mass index, trunk asymmetry or kyphosis) and LBP are null or a weak association in children (Kaspiris, 2010; Nissinen, 1994; Poussa, 2005). In adults, Pope et al. reported no associations between anthropometry and LBP (Pope, 1984). However, a weak association is shown between body weight and LBP (Leboeuf-Yde, 2000), and obesity (high body mass index) associated with LBP (Heuch, 2010).

Spine mobility, muscle strength and posture are included in the examination for LBP. Reduction of spine mobility and muscle strength, change of posture and activity, and disable walking are seen in most subjects with LPB due to pain in many cases. However,

spine mobility or muscle strength seems to have poor association with the incidence of LBP, as it is considered that these losses are secondary (Andersson, 1992). Hamberg-van Reenen et al. in systematic review found that strong evidence that there was no relationship between trunk muscle endurance and the risk of LBP. Moreover, inconclusive evidence for a relationship between trunk muscle strength or mobility of lumbar spine and the risk of LBP was found (Hamberg-van Reenen et al., 2007). There is the report that sagittal spine mobility, static spinal posture, muscle endurance and spinal repositioning error show no difference between subjects with LBP and without LBP (Mitchell et al., 2009). Conflicting evidence is found for the association between physical activity and LBP in the general population and in school children in 10 high-quality studies (Sitthipornvorakul, 2011). They reported high level physical activity at leisure time related to decreased prevalence of LBP and high level physical activity at work combined with low physical activity in leisure time associated with high prevalence of LBP. Also, Heneweer et al. in systematic review reported that there was strong evidence that intense physical exertion during leisure time (regular home improvement activities and high perceived load in, and regular and high intensity sports, and physical exercise in the upper percentile) was moderately (1.0-2.6) associated with LBP, and everyday physical activities in leisure time and the performance of gardening/yard work were found to be strongly (0.20-0.76) to moderately (0.38-0.80) associated with decreased risk for LBP (Heneweer, 2011).

In the relationship between socioeconomic status and LBP, most studies concluded education is strongly associated with LBP, with a high prevalence and risk of LBP for those with low educational level (Astrand, 1987; Latza et al., 2004; Leclerc et al., 2009; Leino-Arjas et al., 1998). In addition, it is reported that prevalence and risk of LBP is high for those with low-income occupational status and manual workers. Latza et al. also reported that severe current back pain was related to educational level and health insurance status, and members of sick funds for white-collar workers (OR 2.81) and private insurance (OR 2.81) and individuals with intermediate educational level (OR 1.76) utilized more physical therapy for the treatment of back pain (Latza et al., 2004). Severe LBP was less prevalent among adults of higher socioeconomic status (Latza et al., 2000).

It is reported that LBP is associated with smoking in lifestyle factors, though the risk of LBP is depended on smoking history (OR 1.15-1.46 in men), (Leino-Arjas et al., 1998). Smoking is positively associated with both prevalent and future LBP (OR 1.38-6.38), (Hestbaek, 2006). Leboeuf-Yde et al. reported that there was a significant positive association between smoking and LBP that increased with the duration and frequency of the LBP problem, but this association was not appeared in monozygotic twins (Leboeuf-Yde et al., 1998). Leboeuf-Yde also concluded that smoking should be considered a weak risk indicator and not a cause of LBP (Leboeuf-Yde, 1999).

2.4 Prevention of occupational LBP

Both workers and managers should make efforts to prevent occupational LBP. Improvement of work conditions and the working environment leads to workers' understanding of occupational health issues. The three main preventive approaches as concepts are:

1. Designing the job to fit the worker,
2. Selecting the appropriate worker for the job, and
3. Teaching the worker to use the correct work method (Andersson, 1991).

Moreover, prevention measures are different dependent on the stage of occupational LBP i.e. before and after the occurrence of occupational LBP, and acute, sub-acute or chronic LBP. Classic preventive medicine divides prevention into three categories: primary, secondary and tertiary prevention. Primary prevention of occupational LBP is designed to prevent the onset of LBP by avoiding or decreasing as thoroughly as possible the risk factors that are shown by epidemiological study. Therefore, the health care professional should know what constitutes LBP risk. Occupational factors are more important for disability than for disease or injury, and few individual risk factors hold up to scientific scrutiny. The three main alternatives in primary prevention are a pre-employment screening programme, improvements in work habits and changes at the workplace. Secondary prevention is designed to share knowledge about the risks of, or the problems associated with, LBP, with the added problem of early disease (risk) detection. In tertiary prevention, selection of the appropriate therapy to reduce the disability and chronicity of LBP and to prevent recurrence may be the most immediate and practical prevention method. However, this would be totally redundant if primary prevention could be made effective (Andersson, 1991).

In Japan, the guidelines for prevention of LBP (Ministry of Labour, 1994) concretely show how to exclude causes of LBP and how to promote the maintenance and improvement of workers' conditions:

1. work management: a) automation and saving of labour, b) working postures and movements, c) working standards, d) breaks, and e) others,
2. work environmental management: a) temperature, b) lighting, c) flooring conditions for work, d) working space, and e) equipment arrangement,
3. health management: a) pre-employment and periodic medical examination, post-measures, and b) doing exercise before work (warming up) and exercise against LBP,
4. education for occupational health: a) education for occupational health and others.

In addition, the guidelines mention specific measures about 5 types of work (heavy load handling, care work in facilities for severe physically and mentally disabled children, standing work with excessive burden to the back, sitting posture with excessive burden to the back and driving for a long time) where LBP occurs comparatively frequently (Ministry of Labour, 1994). The guidelines demand improvement of working condition and the working environment by the enterprises or employer.

Prevention of occupational LBP is designed to reduce workplace risk at first. This requires the reduction of physical demands by improvement of the workplace (safe working environment such as enough space, arrangement of equipment adapting to workers and temperature), work task (saving of works such as automation, reduction of the weight, shape and size of the load and movement distance), work organization (duration and frequency of loading, rests and supports among workers) and the provision of education and training. The National Institute for Occupational Safety and Health (NIOSH) shows how to improve the workplace (engineering and administrative improvements) in ergonomic guidelines for manual material handling (Cheung et al., 2007). This guideline explains the safety methods for manual material handling in the workplace with pictures.

Carter and Brirrell edited "occupational health guidelines for the management of low back pain at work" (Carter & Brirrell, 2000) and Waddell et al. reported evidence in a review of

these guidelines (Waddell & Burrton, 2001). In prevention, there were 3 strong pieces of evidences (provided by generally consistent findings in multiple, high quality studies), 2 limited or contradictory findings (provided by one scientific study or inconsistent findings in multiple scientific studies) and 1 finding with no scientific evidence (based on clinical studies, theoretical consideration and/or clinical consensus) (Carter & Brirrell, 2000; Waddell & Burrton, 2001), (Table 3).

Strong evidence
Traditional biomechanical education based on an injury model does not reduce future LBP and work loss.
Lumbar belts or supports do not reduce work-related LBP and work loss.
Low job satisfaction and unsatisfactory psychosocial aspects of work are risk factors for reported LBP, health care use and work loss, but the size of that association is modest.
Limited or contradictory evidence
Various general exercise/physical fitness programmes may reduce future LBP and work loss; any effect size appears to be modest.
Joint employer-worker initiatives can reduce the number of reported back injuries and sickness absences, but there is no clear evidence on the optimum strategies and inconsistent evidence on the effect size.
No scientific evidence
Educational interventions which specifically address beliefs and attitudes may reduce future work loss due to LBP.

Table 3. Evidences of prevention of LBP (Carter & Brirrell, 2000; Waddell & Burrton, 2001)

Personal preventions of LBP include an exercise programme for improvement of muscle strength, muscle flexibility, muscle balance and spinal movement, back belts and education before onset LBP. Additionally, rest, traction, joint mobilization, acupuncture, physical therapy, hydrotherapy, electrical therapy and behavioural treatment can be used. European guidelines for the prevention of LBP indicate the interventions for prevention of LBP and evaluate the interventions at the evidence level A to D (The COST B13 Working Group, 2004b). The strength of recommendations is based on the 4-level rating: Level A is generally consistent findings provided by (a systematic review of) multiple RCTs, Level B is generally consistent findings provided by (a systematic review of) multiple weaker scientific studies, Level C is one RCT/weaker scientific study or inconsistent findings provided by (a systematic review of) multiple weaker scientific studies and Level D is no RCTs or no weaker scientific studies. The guidelines focus on providing a set of evidence-based recommendations to prevent LBP and/or its consequences in the workforce. Interventions aim at preventing LBP in the workforce can be categorized into 1) individual focus, 2) physical ergonomics, and 3) organizational ergonomics. Recommendation shows in Table 4.

It is difficult to prevent LBP because there are many factors that contribute to LBP and preventive effects can be different according to each individual. Therefore, appropriate prevention of LBP needs to be provided against future LBP, recurrence of LBP, chronic LBP, worsening LBP and so on.

Physical exercise / physical activity Recommendation. Physical exercise may be recommended in prevention of LBP (Level A). Physical exercise may be recommended in prevention recurrence of LBP (Level A) and in prevention recurrence of sick leave due to LBP (Level C). Information / advice / instruction Recommendation. Traditional information/advice/instruction on biomechanics, lifting techniques, optimal postures etc is not recommended for prevention in LBP (Level A). there is insufficient evidence to recommended for or against psychosocial information delivered at the worksite (Level C), but information oriented toward promoting activity and improving coping, can promote a positive shift in beliefs (Level C). Whilst the evidence is not sufficiently consistent to recommend education in the prevention of recurrence of sick leave due to LBP (Level C), incorporating the messages from the accompanying clinical guidelines into workplace information/advice is encouraged. Back belts / lumber supports Recommendation. Back belts/lumber supports are not recommended for prevention in LBP (Level A). Shoe inserts, shoe orthoses, shoe in-soles, flooring and mats Recommendation. Shoe inserts/shoe orthoses are not recommended for prevention in LBP (Level A). There is insufficient evidence to recommend for or against shoe in-soles, soft shoes, soft flooring or antifatigue floor mats (Level D). Physical ergonomics Recommendation. There is insufficient consistent evidence to recommended physical ergonomics interventions alone for reduction of the prevalence and severity of LBP (Level C). There is insufficient consistent evidence to recommended physical ergonomics interventions alone for reduction of [reported] back injuries, occupational or compensable LBP (Level C). There is some evidence that, to be successful, a physical ergonomics programme would need an organisational dimension and involvement of the workers (Level B). There is insufficient evidence to specify precisely the useful content of such interventions (Level C), and the size of any effect may be modest. Organisational ergonomics Recommendation. There is insufficient consistent evidence to recommend stand-alone work organisational interventions alone for prevention in LBP (Level C), yet such interventions could, in principle, enhance the effectiveness of physical ergonomics programmes. Modified work for return to work after sick leave due to LBP Recommendation. Temporary modified work (which may include ergonomic workplace adaptations) can be recommended, when needed, in order to facilitate earlier return to work for workers sick listed due to LBP (Level B)

Table 4. Summary of recommendations of the interventions for prevention of LBP for workers (The COST B13 Working Group, 2004b)

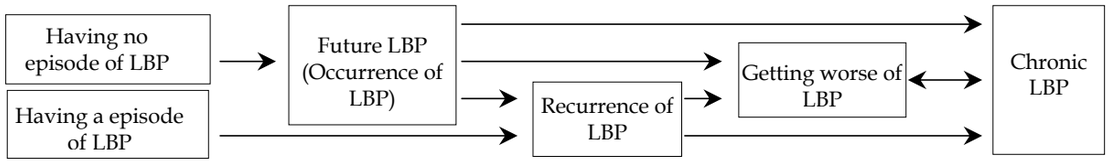

Fig. 7. Prevention and/or intervention of LBP are needed on the every stage (arrows).

3. Conclusion

Many people suffer from LBP. It is considered that the lifetime prevalence of LBP ranged from 50% to 80% and about half of the population experienced LBP in a year. As occupational LBP can occur in most workers in various jobs, it is both an individual and social problems. Accidental LBP tends to occur in the morning (8:00-11:00) at the beginning of week. It is considered that there is the evidence that increased risk of LBP is associated with heavy physical work, manual material handling, awkward posture and whole body vibration among physical factors, and job dissatisfaction and low social support among the psychosocial factors and socioeconomic status (low education and occupational status) among the personal factors. These factors interact with the onset of LBP directly or indirectly. Therefore, employers must take measures to reduce the risk factors for LBP by improvement of the workplace, work task and work-organization designs, and education and training. Workers must take measures to prevent LBP similar to those undertaken by employers. There is evidence that physical exercise may be recommended in the prevention of LBP and the prevention of the recurrence of LBP. It is considered that prevention of LBP can be effective if the exercise programme matches the individuals, as there is contradictory evidence and any effect in reducing LBP by various general exercise programmes. We should take suitable measures fitting the stages (i.e. future LBP, present LBP and continuous LBP) to prevent LBP, disability and so on. Needless to say, it is important to make sure of the causes of LBP in the past, present and future. Therefore, health care professionals should understand the risk factors for LBP and fully understand the subjects with LBP and their circumstances. These should be applied to all workers.

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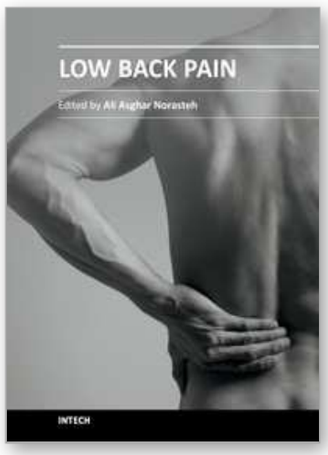

Low Back Pain

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This book includes two sections. Section one is about basic science, epidemiology, risk factors and evaluation, section two is about clinical science especially different approach in exercise therapy. I envisage that this book will provide helpful information and guidance for all those practitioners involved with managing people with back pain-physiotherapists, osteopaths, chiropractors and doctors of orthopedics, rheumatology, rehabilitation and manual medicine. Likewise for students of movement and those who are involved in re-educating movement-exercise physiologists, Pilates and yoga teachers etc.

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