CISM INTERNATIONAL SYMPOSIUM
PRETORIA - SOUTH AFRICA
1996

THE RELATIONSHIP BETWEEN CERTAIN PHYSICAL PARAMETERS AND THE INCIDENCE OF REPORTED LOW-BACK PAIN IN MANUAL LABOURERS

Lt D.SIEBERT (South Afr)

INTRODUCTION

South Africa as an industrial developing country is to a large extent still dependent on manual labour, despite mechanisation. At present some 38,5% of labourers in the industry perform some kinds of manual labour (Malan,1988). This places a great demand on the physical capabilities of manual labourers, which could be a causative factor in work-related injuries and lower productivity.
Due to the demands placed upon manual labourers, they must posses certain minimum physical capabilities to be able to perform their tasks effectively (Campion, 1983). According to Fleishman (1979); Cady et al. (1979); Cox et al. (1979) and Vorster (1988), physical parameters such as cardiorespiratory endurance, physical strength, flexibility and anthropometric measurements such as stature and body mass are also important factors in determining physical work ability.

Shepherd (1969) regards cardiorespiratory endurance as one of the most important factors contributing to physical work performance. Cady et al. (1979) and McQuade et al. (1988) provide evidence that improved cardiorespiratory condition is associated with fewer back problems in physically demanding jobs. Vallfors (1985) also found that physically well conditioned persons have a statistically significant lower frequency of low back pain than persons who are not physically well conditioned.

Back pain is a major concern to the industry, because it is the most expensive health care problem of the 20 to 50 year age group (Bigos, 1986; Spengler, 1986). Back pain is the reason most frequently stated in time-lost claims filed (Venning,1987). Usually, the calculated costs of back pain exclude the loss of productivity and replacement training costs. The work-place environment is an important factor influencing the incidence of low back pain (Frymoyer et al. (1983). International research indicated that individuals with a low physical ability had a higher incidence of work related injuries (Chaffin 1974; Knave et al.1991) and a higher incidence of absenteeism (Cox et al.(1981); Knave et al.(1991).

It is also important to have sufficient strength to meet the particular demands of a job. Chaffing (1974) found that men who did not demonstrate lifting strength equal to that required by their jobs which entailed moderate to heavy lifting, had a higher incidence of job-related low back complaints. Clemmer (1991) found that individuals who increased their strength by exercising, also increase their resistance to injury. Biering-Sorenson (1984) and Rowe (1969) state that isometric strength of the trunk muscles is of value for predicting first-time occurrence of low back pain. They found a decrease in abdominal and back muscle strength among patients with back pain.

Rowe (1969) and Biering-Sorenson (1984) found that tightness of the biceps femoris muscles is of value for predicting the occurrence of low back pain. Persons with low back pain display decreased range of motion in the flexion and extension of the trunk and hip.

Very little related research has been conducted in South Africa. An in-house investigation conducted recently at a South African steel manufacturing company that 5% of all reported on-job injuries were related to lower back injuries. It was found that only 45% of the individuals with back injuries had a history of back injuries (Venter,1990).

It was therefore decided to conduct a study to establish the relationship between the physical capabilities of currently employed manual labourers in two industrial settings and the reported

incidence of back pain.

METHODS

Subjects

Persons performing hard manual labour during their work day were selected for this study. 135 male employees from two companies in the steel and cement industries were subjected to a physical selection. Representative groups were subjected to the physical selection in both companies. Employees were selected according to foreman's/supervisor's judgement of good, average and poor employees.

Test Items

Once the employees were selected each person was subjected to a test battery designed for physical selection. It consisted of the following tests: determining of body mass, stature and flexibility of the hamstring muscle group, 6 minute cycle ergometer test at 100W, static strength test for back strength, leg strength, are shoulder strength and grip strength and an abdominal muscle endurance test for 1 minute.

Procedure

(i) Mass stature

Each employee's mass (kg) and stature (cm) was measured with an electronic scale and a stadiometer respectively and recorded.

(ii) Flexibility

The employee's hamstring and lower back flexibility was determined with the sit and reach test as described by Kirkendall et al.(1987).

(iii) Bicycle ergometry

A single test bicycle ergometer test was performed at 100W on a mechanically braked Monark bicycle ergometer (model 824E). This served as the stamina component of the test battery. Before commencing with the test, the resting blood pressure and heart rates were monitored and recorded. Time was allowed to the person to become acquainted with the activity and the suggested rhythm before any load was applied, as most employees were unaccustomed to this kind of activity. The test lasted for 6 minutes, with a pedalling speed of 60 r.p.m. The heart rate was monitored in the last 30 seconds of the test and recorded.

Five minutes were allowed for recovery from the ergometry.

(iv) Static strength tests

Strength test were done by using dynamometers. The following tests were performed:

a. Grip strength (left and right)
b. Arm and shoulder strength
c. Back strength
d. Leg strength

The results were all recorded in kilograms. The strength tests were performed in the same order as described above. The following procedures were followed with each test:

a. Grip strength

A demonstration as given to the employees. Grip strength of both hands was determined by using a grip strength dynamometer, where 3 trials were allowed with each hand and the best effort was recorded.

b. Arm and shoulder strength

A special apparatus was developed with a dynamometer attached to it, to evaluate the muscle groups of the shoulders and arms. Two trials were allowed after demonstration was given and the best score was recorded.

c. Back strength

The apparatus mentioned above was used for this measurement. The apparatus has special adaptations to allow the isolation of the back muscles. A demonstration was given after which two trials were allowed. The best score was recorded.

d. Leg strength

The same apparatus which was mentioned in b and c was used, once again with its special adaptations to isolate the muscle of the legs. Two trials were allowed and the best score was recorded after a demonstration.

(v) Abdominal muscle endurance

The subjects were given 5 minutes for recovery after the strength tests. The abdominal muscle endurance was evaluated by using sit-ups with bent legs. The feet were kept steady with a strap in which they were hooked. The legs were bent at 90 degrees. The hands were kept behind the head while the head was bent forward touching the chest. The test procedure followed is described by Kirkendall et al. (1987). The maximum number of sit-ups completed in one minute was recorded. Each time the shoulders touched the bench surface, a sit-up was counted.

(v) Incidence os low-back pain

The reported incidence of low-back injuries was determined by analyzing each individual's medical file. The incidence of low-back pain was recorded when a medical certificate was found stating that the individual suffered from low-back pain. A total of 20 individuals were found out of the group of the 135 to have reported low-back pain.

RESULTS AND DISCUSSION

Based on previous research, it was expected in this study that correlation would be found between lesser strength and a greater incidence of low back pain. The mean values, standard deviations and the maximum and minimum values were calculated for each parameter measured. The non low-back pain group showed greater values in back strength, leg strength, abdominal muscle endurance and flexibility. This group also showed lower exercise heart rates.

The difference between the groups was visible yet not very large. The most probable reason for not

finding a larger difference between the two groups with regard to the physical parameters measured is the criterion used to determine the incidence of low-back problems. The incidence of low-back problems was determined only by analyzing each test person's medical report file. Low-back incidences were recorded only if a doctor's certificate was found in the file and the person was absent from work due to the complaint. It is very likely that far more individual experienced low-back problems, but that these incidents went unreported, especially if low-back pain was not always experienced intensely or often.

A similar, yet informal study was done with South African Air Force members. Self-reported low-back pain was recorded during biokinetic evaluations as well as the stature, body mass, percentage body fat, cardiorespiratory fitness, abdominal muscle endurance and flexibility of the hamstring muscle group and the lower back. A definite correlation existed between a lack of flexibility in the hamstring and lower-back and poor abdominal muscle endurance and the occurrence of low-back pain.

Now that the problems have been identified what can be done to eradicate them? The SANDF has trained biokineticists in their service who are equipped with the knowledge to evaluate persons with such complaints and prescribe an individualised exercise program to address the problem of low-back pain. The infrastructure is in place for further medical treatment if the condition is of such nature that other medical disciplines must be consulted.

Presently all persons 35 years and older in the SANDF must complete an annual biokinetic evaluation to assess their general physical well-being. The evaluation includes resting and exercise/stress EKG monitoring, resting and exercise blood pressure and heart rate readings, a multi-level exercise test on a cycle ergometer, determining of body composition, flexibility of hamstrings and lower back abdominal endurance.

Feedback on the evaluation is given to each person after testing. It is the persons choice then to follow an individual prescribed program according weakness in the evaluation. All of the SAAF units have very well equipped gymnasiums which can be used by all members. Home programs are also given if the person does not wish to use the gymnasium or he/she travels a lot.

According to researchers up to 90% of back operations could be avoided by doing the appropriate exercises regularly and by teaching people to doing everyday chores in a "back friendly" manner. Doing things the correct way and exercising must become a lifestyle. The cost of such intervention is far less than cost of surgery. These interventions will therefore mean a decrease in the loss of productivity, absenteeism, medical expenses and replacement of skilled personnel.

The bottom line is self responsibility. Individual should not look towards any other person but themselves for a better back condition.

CISM INTERNATIONAL SYMPOSIUM
PRETORIA - SOUTH AFRICA
1996

TABLE 1 PARAMETERS MEASURED IN THE NO REPORTED LOW-BACK PAIN GROUP

PARAMETER	MEAN	MAX. VALUE	MIN. VALUE
Stature (cm)	169.85	182.00	157.00
Body mass (kg)	72.45	91.00	49.00
Arm/shoulder strength (kg)	104.35	162.00	70.00
Back strength (kg)	95.15	140.00	45.00
Leg strength (kg)	209.25	320.00	125.00
Abdominal muscle endurance	25.20	46.00	16.00
Flexibility (cm)	40.15	52.00	29.00
Exercise heart rate	135.5	172.00	103.00

TABLE 2 PARAMETERS MEASURED IN THE REPORTED BACK PAIN GROUP

PARAMETER	MEAN	MAX. VALUE	MIN. VALUE
Stature (cm)	170.20	184.00	157.00
Body mass (kg)	69.90	102.00	46.00
Arm/shoulder strength (kg)	102.35	160.00	36.00
Back strength (kg)	84.20	130.00	55.00
Leg strength (kg)	195.20	320.00	105.00
Abdominal muscle endurance	24.15	34.00	19.00
Flexibility (cm)	39.45	52.00	25.00
Exercise heart rate	137.40	176.00	100.00

TABLE 3 COMPARISON OF THE PHYSICAL PARAMETERS MEASURED IN THE NO REPORTED LOW-BACK PAIN GROUP AND THE REPORTED BACK PAIN

PARAMETER	NO LBP	LBP
Arm/shoulder strength (kg)	104.20	102.35
Back strength (kg)	95.15	84.70
Leg strength (kg)	209.25	195.20
Abdominal muscle strength	25.20	24.15
Flexiblity (cm)	40.15	39.45
Exercise heart rate	135.5	137.40

LBP = LOW-BACK PAIN

REFERENCES

BATTIE,M.C., BIGOS,S.J., FISHER,L.D., HANSSON,T.H.,NACHEMSON,A.L., SPENGLER,D.M.,WORTLEY,M.D., ZEH,J. 1989,A Prospective study of the role of cardiovascular risk factors and fitness in industrial back pain complaints, *Spine*, 14, 141-147.

BATTIE,M.C., BIGOS,S.J., FISHER,L.D., HANSSON,T.H., JOES,M.E., WORTLEY,M.D., 1989. Isometric lifting strength as a predicator of industrial back pain reports, *Spine*, 14,851-855.

BIETING-SORENSON,F.1894, Physical measurements as risk indicators for low back trouble over a one-year period. *Spine,*9,106-119.

BIGOS,S.J., SPENGLER,D.M., MARTIN,N.A., ZEH,J., FISHER,L.D., NACHEMSON,A.L.1986. Back injuries in industry: A retrospective study. III. Employee-related factors, *Spine,*11,252-256.

CADY,L.D., BISCHOFF,D.P., O'CONNELL,E.R., THOMAS,P.C., ALLAN,J.H.1979, Strength and fitness and subsequent back injuries, *Journal of Occupational Medicine.* 21,269-272.

CAMPION,M.A.1983. Personnel selection for physically demanding jobs: Reviews and recommendation.-*Personnel psychology,*36,527-550.

CHAFFIN,D.B.1974, Human strength capability and low back pain. *Journal of Occupational Medicine.* 16,248-254.

CLEMMER,D.J., MOHR,D.L., MERCER,D.J. 1991, Low back injuries in a heavy industry: I. Workers and Workplace factors. *Spine,* 16,824-830.

CIX,M.,SHEPHARD,R.J.,CORE,P. 1981. Influence of an employee fitness programme upon fitness, productivity and absenteeism.*Ergonomics.*24,795-806.

FLEISHMAN,E.A.1979. Evaluating physical abilities required by jobs. *Personnel administrator.*24,82-92.

FRYMOYER,J.H., POPE,M.H., CLEMENTS,J.H., WILDER,D.G., MACPHERSON,B., ASHIKAGA,T. 1983. Risks factors in low back pain. *The Journal of Bone and Joint Surgery,* 65,213-218.

KIRKENDALL,D.R.,GRUBER,J.J., JOHNSON,R.E.1987. Measurement and evaluation for physical educators (Human Kinetics Publishers,Champaign),553.

KNAVE,B., PAULSSON,H., FLODERUS,B., GRONKVIST,L., HAAGGSTROM,T., JUNGETEG,G., NILSSON., VOSS,M., WENNBERG,A. 1991. Incidence of work-related disorders and absenteeism as tools in the implementation of work environment improvements: The Sweden post strategy, *Ergonomics*, 34,841-848.

MALAN,D.D.J.1988. Physical evaluation as method for pre-employment selection and placing and towards increasing productivity and reducing risk of injury. Presentation at NOSCON,1-11.

MCQUADE,K.J., TURNER,J.A., BUCHNER,D.M. 1988, Physical fitness and chronic low back pain. *Clinical Orthopaedics and related research.*233,198-294.

SHEPHAND,R.J.1969. Endurance fitness. (University of Toronto Press,Toronto),246.

SPENGLER,D.M., BIGOS,S.J., MARTIN,N.A., ZEH,J., FISHER,L.D., NACHEMSON,A.L. 1986, Back injuries in industry: A retrospective study. I.Overview and cost analysis. *Spine.*11,241-245.

VALLFORS,B. 1985, Acute, subacute and chronic low back pain: Clinical symptoms, absenteeism and working environment.*Scandinavian Journal of Rehabilitation Medicine.* 198, 1-98.

VENNING,P.J., WALTER,S.D., STITT,L.W. 1987, Personal and job-related factors as determinants of incidents of back injuries among nursing personnel. *Journal of Occupational Medicine.* 29,820-825.

VENTER,H. 1990, Iscor report on back injuries. 1-5.

VORSTER,G.P. 1988, 'n Fisieke evalueringsmodel vir Swart hande arbeiders in die boubedryf, (Potchefstroom),14-27.

****