LOW BACK PAIN IN ADOLESCENT FEMALE ROWERS AND THE ASSOCIATED FACTORS

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There were two aims of the current study; firstly, to determine the incidence of low back pain in adolescent female rowers and secondly, to determine the differences between LBP and no-LBP groups for a range of physical tests and psycho-social variables. The point prevalence of LBP was 47.5% for rowers and 15.5% for controls indicating that LBP is common in this group of rowers. When no-LBP and LBP groups were compared for the data collected in this study, LBP subjects showed significantly decreased lower limb endurance and back muscle endurance and sitting with more erect postures. Although this study cannot determine causation, it has the potential to direct interventions to decrease the incidence of LBP in this group.

KEY WORDS: adolescent, rowing, low back pain, motor control, sitting.

INTRODUCTION: High levels of physical activity such as that involved in rowing are considered to have a positive impact on physical and mental health. However, low back pain (LBP) is common in rowers. Whilst there has been a paucity of research examining factors associated with, or causative of LBP in rowing, it can be hypothesised that there a combination of etiological factors. These factors may include; excessive training volume, motor control impairments of the trunk, repetitive flexion and axial rotation of the trunk while rowing, deficits in spinal proprioception, increased joint hypermobility, reduced lower limb muscle endurance and back muscle endurance leading to increased passive tissue strain, rowing technique (sweep or scull rowing) as well as psycho-social factors. Therefore, LBP in rowing should be investigated using a bio-psycho-social model (Waddell, 2004).
It is very important to prevent episodes of LBP in adolescence as it is a risk factor for LBP in later life (Hestbaek et al., 2006) and in adolescence, LBP increases with age, and is more common in females (Balague et al., 1999). Therefore, research examining LBP disorders in female adolescents in rowing, where there is clinical evidence of a high incidence of LBP and the associated disability is of concern is important. Currently, no data exists on the exact incidence of LBP in a large female adolescent rowing population. Further, there is no research that has investigated the factors associated with LBP using a battery of relevant physical and psycho-social measures. Therefore, there were two aims of the study; firstly, to determine the incidence of LBP amongst a group of female adolescent rowers and secondly, to determine what variables were associated with LBP in this population.

METHODS: In the first part of this study 356 adolescent female rowers between 14-17 years and 496 age and socio-economic status matched asymptomatic active control subjects completed a questionnaire to determine the prevalence of LBP and other factors known to exacerbate LBP. In the rowers there were 153, 116, 50 and 37 subjects in the 14,15,16 and 17 year old groups respectively, whilst in the non-rowing group there were 207, 232 and 57 subjects in the 14, 15 and 16 years age groups. In the second part of the study 60 rowers (30 LBP and 30 no-LBP subjects) were then invited to volunteer for further testing (Table 1). The inclusion criteria for this portion of the study were; all subjects had to row in both sweep and scull boats, and for the pain group the level of pain whilst rowing had to be greater than 3/10 and the level of disability had to be greater than 12%.

Table 1: Characteristics of the no-LBP and LBP groups.

	No-LBP (N=30)	LBP (N=30)
Age (years)	15.2 (1.1)	15.1 (1.2)
Height (m)	1.69 (0.10)	1.68 (0.10)
Mass (kg)	58.2 (9.2)	59.3 (8.4)
Physical Activity (METS)	5627.0 (2798.8)	6228.0 (4151.5)
Pain - Usual (/10)		2.2 (1.9)
Pain – Rowing (/10)		5.8 (1.9)
Disability (%)		22.4 (9.0)
Fear of Movement (au)		19.1 (3.5)

In the second part of the study, subjects were invited to complete a series of questionnaires as well as completing a battery of physical tests. The level of LBP was determined by the Visual Analog Scale for pain measurement and the level of disability was measured by the revised-Oswestry Questionnaire (Hudson-Cook et al., 1989). Psycho-social questionnaires included the Child Behaviour Checklist (Harris et al., 1993) and the Back Beliefs Questionnaire (Symonds et al., 1995). Fear of movement was measured using the Tampa Scale of Kinesophobia (Kori et al., 1990) and physical activity levels were determined using the International Physical Activity Questionnaire (Booth, 2000). Physical tests included; lumbar spine proprioception, (O'Sullivan et al., 2003), lumbo-pelvic posture in both usual and slumped sitting (Dankaerts et al., 2006), isometric back muscle endurance (Beiring-Sorenson, 1984), isometric lower limb endurance, and joint hypermobility (Dijkstra et al., 1994).

Three-dimensional (3D) lumbo-pelvic data for usual and slumped sitting and spinal proprioception were recorded at 25Hz using an electromagnetic device (3-Space FastrakTM, Polhemus Navigation Science Division, Kaiser Aerospace, Vermont). Sensors were placed on the skin over the spinous processes of T12, L3 and S2. For usual and slumped sitting testing, subjects sat on a flat stool with no back support in their typical manner and no instructions on how to sit were provided except to have the knees flexed at 90°. Subjects were then assisted into their end range lumbar flexion sitting posture via the pelvis, by an experienced physiotherapist. Mean lumbar angle in these postures was determined over three seconds (Dankaerts et al., 2006). Spinal proprioception was evaluated with subjects attempting to reproduce a neutral lordosis in sitting (O'Sullivan et al., 2003). Each subject sat on a flat stool and was assisted to move through their available range of lumbar flexion and extension three times. They were positioned into a neutral lordosis for five seconds and instructed to remember the position. They were then asked to find it as accurately as possible during the test trials. Subjects were instructed to relax into full lumbar flexion for five seconds, before being asked to reproduce the test position. This protocol was repeated three times. Isometric back muscle endurance was measured using the Beiring-Sorenson test. Subjects were required to lie prone on a plinth with their pelvis stabilised and their trunk over the edge of the plinth. The subject was asked to straighten their back and to hold their trunk parallel to the floor for as long as possible and time was measured from the moment the subject achieved a straight position until the trunk dropped to 15° from the horizontal plane. Isometric lower limb endurance utilised a similar approach with the time being measured with the subject in an isometric semi-squat posture with the hips and knees postured at 90 degrees.

Descriptive statistics were calculated for the first part of the study. Independent t-tests were used to determine whether differences exist between the LBP and no-LBP groups for all variables. Statistical procedures were conducted using SPSS V11.0 and the level of significance was set at $p<0.05$.

RESULTS AND DISCUSSION: LBP was common in adolescent female rowers. The point prevalence of LBP was 47.5% for the adolescent female rowers and 15.5% in the control group. When stratified by age, 52.3%, 39.7% and 46.0% and 54.1% of 14, 15, 16 and 17 year-olds had LBP respectively. Increased levels of pain were experienced by subjects whilst rowing when compared to their usual levels (Table 1) indicating that rowing exacerbated their pain. Self reported factors considered to cause, or exacerbate LBP in rowing, included; long rows in a training session (78.9% of subjects), lifting a rowing shell (69.9%) and rowing in a sweep eight (64.2%). Rowing a single scull or quadruple scull were less common factors (13.8% and 36.6% respectively). The most common reasons for LBP affecting everyday function determined by the revised-Oswestry questionnaire were sitting, lifting and standing with mean (SD) values of 1.7(1.0), 1.7(1.1) and 1.4(1.1) (as score out of 5) respectively. Total rowing related training hours increased as the subjects increased in age with the average training being 6.7, 7.7, 9.2 and 9.4 hrs/wk for the 14, 15, 16 and 17 year olds respectively. Dry land training (including rowing ergometers) consisted of 1.1, 1.5, 1.9 and 2.2 hrs/wk respectively. Further, 65.7% of subjects spent less than 5 hours/week with other sporting interests.

There were no significant differences evident between the no-LBP and LBP groups for psycho-social variables or beliefs about LBP. Data for the physical testing are presented in Table 2. Differences were found between the no-LBP and LBP groups for lower limb endurance and back muscle endurance in addition to the pelvic tilt during usual sitting and the difference in pelvic tilt for usual and slump sitting.

Table 2: Physical testing data for the no-LBP and LBP groups.

	No LBP (N=30)	**LBP (N=30)**	**p-value**
Lower Limb Endurance (sec)	73.6 (28.7)	48.3 (27.7)	0.001
Back Muscle Endurance (sec)	106.0 (55.2)	79.1 (44.2)	0.040
Joint Hypermobility (au)	2.1 (1.9)	2.9 (2.2)	0.136
Lumbar Repositioning (cms)	2.0 (1.4)	1.4 (0.9)	0.075
Pelvic Tilt-Usual (°)	-2.8(9.7)	-7.8 (8.8)	0.040
Lower Lumbar Angle-Usual (°)	4.0(9.8)	7.6 (9.3)	0.153
Pelvic Tilt-Slump (°)	5.0 (10.2)	9.1 (9.6)	0.104
Lower Lumbar Angle-Slump (°)	-10.2 (9.7)	-10.5 (8.7)	0.887
Pelvic Tilt-Difference (°)	7.8 (9.9)	16.9 (11.5)	0.001
Lower Lumbar-Difference (°)	14.4 (10.1)	18.1 (11.5)	0.179

Lower limb muscle endurance is an important factor for rowing as the legs initiate and assist in the drive phase of the rowing stroke. If the legs are prematurely fatigued and therefore complete their extension too early and/or are unable to produce pre-requisite force levels it could be hypothesised that the rower's back is the main contributor to produce force on the oar. There is evidence of such a substitution pattern in repetitive lifting (eg. Sparto et al., 1997). Poor back muscle endurance may render the spine vulnerable to increased tissue strain. Possible causes of reduced back muscle endurance might include disuse through inactivity (Moffroid et al., 1994), poor general conditioning, altered motor control patterns (O'Sullivan et al, 1997) or habitual positioning of the spine in postures associated with reduced activity of spinal stabilizing muscles (O'Sullivan et al., 2005). The statistically significant data pertaining to pelvic tilt in usual sitting indicated that the LBP group displayed more anterior pelvic tilt when compared to the no-LBP group. In slump sitting, the LBP group showed more posterior pelvic tilt when compared to the no-LBP group but this difference was not statistically significant. These opposing pelvic postures in usual and slumped sitting resulted in a significant difference between usual and slump sitting. There were no significant differences evident for the lower lumbar angle in either usual or slump sitting. These findings suggest that the subjects sat in more erect and forward inclined sitting postures which may result in increased spinal loading. What relationship these sitting postures have to rowing posture is the focus of future investigations.

CONCLUSIONS: This study found that LBP is common in adolescent female rowers which is of concern as the first episode of LBP is the biggest risk factor for LBP later in life. Further there were subjects with high levels of related functional disability. Factors associated with LBP in this group were reduced lower limb endurance and back muscle endurance and maintaining more erect sitting postures. Although the question of cause and effect cannot be answered without a prospective study, the current study provides evidence to direct multi-disciplinary intervention strategies to decrease the prevalence of LBP in this group.

REFERENCES:

Balague, F., Troussier, B. & Salminen, J.J. (1999). Non-specific low back pain in children and adolescents: risk factors. European Spine Journal, 8, 429-438.

Biering-Sorensen, F.l. (1984). Physical measurements as risk indicators for low back trouble over a one year period. Spine, 9, 106-118.

Booth, M.L. (2000). Assessment of physical activity: An international perspective. Research Quarterly for Exercise and Sport, 71, S114-S120.

Dankaerts, W., O'Sullivan, P., Burnett, A. & Straker, L. (2006). Differences in sitting posture are associated with non-specific chronic low back pain disorders when patients are sub-classified. In Press, Spine.

Dijkstra, P.U., de Bont, L.G., van der Weele, L.T & Boering, G. (1994). Joint mobility measurements: reliability of a standardized method. Cranio, 12, 52-57.

Harris, J., Tyre, C. & Wilkinson, C. (1993). Using the child behaviour checklist in ordinary primary schools. British Journal of Educational Psychology, 63, 245-260.

Hestbaek, L., Leboeuf-Yde, C., Kyvik, K.O. & Manniche, C. (2006). The course of low back pain from adolescence to adulthood: Eight-year follow up of 9600 twins. Spine, 31, 468-472.

Hudson-Cook, N., Tomes-Nicholson, K. & Breen, A. (1989). A revised Oswestry Disability Questionnaire. Manchester: Manchester University Press.

Kori, S.H., Miller, R.P. & Todd, D. (1990). Kinesophobia: a new view of chronic pain behaviour. Pain Management, 3, 35-43.

Moffroid, M., Reid, S., Henry S.M., Haugh, L.D. & Ricamato, A. (1994). Some endurance measures in persons with chronic low back pain. Journal of Orthopaedic and Sports Physical Therapy, 2, 81-87.

O'Sullivan, P.B., Twomey, L. and Allison, G.T. (1997). Evaluation of specific stabilising exercise in the treatment of chronic low back pain with radiologic diagnosis of spondylolysis or spondylolisthesis. Spine, 22, 2959-2967.

O'Sullivan, P., Burnett, A., Floyd, A. et al. (2003). Lumbar repositioning deficit in a specific low back pain population. Spine, 28, 1074-1079.

O'Sullivan, P., Mitchell, T., Bulich, P., Waller, R. & Holte, J. (2005). The relationship between posture, lumbar muscle endurance and low back pain in industrial workers. In Press, Manual Therapy.

Sparto, P., Parnianpour, M., Reinsel, T. & Simon, S. (1997). The effect of fatigue on multijoint kinematics and load sharing during a repetitive lifting test. Spine, 22, 2647-2654.

Symonds, T.L., Burton, A.K., Tillotson, K.M. et al. (1995). Absence resulting from low back trouble can be reduced by psychosocial intervention at the workplace. Spine, 20, 2738-2745.

Waddell, G. (2004). The Back Pain Revolution. Churchill Livingstone: Edinburgh.