Injuries among female army recruits: a conflict of legislation

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SUMMARY

In the final decade of the 20th century, the British Armed Forces came under intense pressure to open up traditionally male roles to female recruits. For training, women were initially given lower entry and exit standards, but it became apparent that many did not possess the strength necessary for their work. This 'gender fair' policy was therefore changed to a 'gender free' policy, whereby identical physical fitness tests were used for selection of male and female recruits and the training programme made no allowances for gender differences. To determine the effects of this policy change, data from medical discharges were examined for the periods before and after implementation, with reference to musculoskeletal injuries of the lower limbs. In the first cohort there were 5697 men and 791 women, in the second 6228 men and 592 women.

The cross-gender (F/M) odds ratio for discharges because of overuse injury rose from 4.0 (95% CI 2.8 to 5.7) under the gender-fair system to 7.5 (5.8 to 9.7) under the gender-free system (P=0.001). Despite reducing the number of women selected, the gender-free policy led to higher losses from overuse injuries.

This study confirms and quantifies the excess risk for women when they undertake the same arduous training as male recruits, and highlights the conflict between health and safety legislation and equal opportunities legislation.

INTRODUCTION

After the Second World War the British Army gradually decreased in size, with National Service conscription ending in 1960. The move to a professional volunteer army brought about a refinement of selection techniques, and entry medical standards changed little throughout the Cold War. After the dissolution of the Warsaw Pact in 1989, the Army underwent further reduction, although it remains the largest single recruiting organization in the UK, processing more than 27 000 applications for enlistment each year. Army recruits come from across the social spectrum although they are typically aged between 17 and 20 and come from lower socioeconomic groups within large conurbations; about 10% are female.

After the Cold War, there was increased pressure for the Armed Forces to adhere to equal opportunities legislation. This included expansion of career choices for women by opening up certain fields that had previously been reserved for males. Successive governments have acknowledged the need to increase the proportion of women in the Army to above 8%, and the widening of career choice for women was viewed as one means to achieve this.

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Before 1994, female recruits were trained in single-sex establishments and the first moves towards wider integration involved bringing recruits together into mixed-sex establishments—the Army Training Regiments. Initially, female recruits were trained to a lower standard of physical fitness, but it became apparent that, as career choice widened, many female recruits were not physically capable of the job for which they had been selected. In April 1998, therefore, a system was introduced by which all recruits would be selected by use of a standard set of physical tests to score candidates in relation to their chosen career. Originally, the system was designed simply to pass or fail an applicant, but in order to assist borderline candidates a grading system was adopted to reflect a 90%, 80% and 60% chance of successfully completing initial training for their chosen trade. This grading system allowed the identification and acceptance of 'risk candidates' for certain trade groups.

On enlistment all recruits are medically screened before beginning the 12-week initial training programme (phase 1 training). They are trained in the basic military skills of marching, drill, weapon handling, equipment handling and field craft before being given specialist training in their chosen trade (phase 2). Such skills require a high standard of physical fitness which develops throughout the period of training. To comply broadly with sex discrimination legislation, no account is made of the physical or physiological differences between the sexes—so called 'gender free' training.

Numerous studies have shown military recruits to be at special risk of stress fractures, back pain, knee pain and achilles tendinitis[1–3]. The aim of this study was to record differences in the health status of recruits that resulted from a change in selection and training policy.

METHOD

In early 1997, a 3-month pilot study was conducted in which 225 medical discharges were recorded. About 40% of medical discharges were found to relate to musculoskeletal injury, of which half were overuse injuries (including stress fractures of the foot, tibia, femur and pubis, back pain and Achilles tendinitis). In addition, about 30% of recruit discharges related to medical conditions that had existed before service, most being discovered in the first 6 weeks of training. Since this latter group ('defective enlistments') was larger than the expected number of overuse injuries, it was excluded from the study population. Voluntary retirements were also excluded.

Although a move to gender-free training seemed likely to increase the rate of overuse injuries in female recruits, there was no information from which to determine the likely size of the rise. Sample size calculations were based on the assumption of a 33% higher rate in women: this necessitated data for at least 5472 recruits, which meant recording of discharge data for two periods of nine months. In view of the size and repetitive characteristics of the recruit population from year to year, age and sex matching was unnecessary. The first period began on 1 July 1997 and ended on the final day of gender-fair selection and training, 31 March 1998. The second period began three months after the introduction of gender-free training, 1 July 1998, and finished on 31 March 1999. The use of identical periods in the recruiting year took account of seasonal recruiting patterns. Overuse injuries were recorded directly from discharge documentation. The influence of gender on the incidence of specified overuse injuries was examined for each corrected cohort and the cross-gender (F/M) odds ratio for each specific injury was determined. Statistical significance was assessed by the χ^2 test and 95% confidence intervals (CI) were calculated by Miettinen's test based approach.

RESULTS

The first cohort, after correction for erroneous enlistments and voluntary departures in the first 6 weeks, consisted of 6488 recruits (5679M; 791F). The second, after similar correction, consisted of 6920 recruits (6228M; 692F). The proportion of women entering training thus fell from 12% to 10%. Population details are in Table 1.

Table 1 **Population data**

	Gender fair		Gender free	
	M	*F*	*M*	*F*
Initial intake	6738	925	7591	848
Defective enlistment	307	37	454	69
Voluntary discharge	734	97	909	87
Study population (*n*)	5697	791	6228	692

Table 2 **Data by gender, site of injury and cohort**

	Gender fair		Gender free	
	M (5697)	*F(791)*	*M (6228)*	*F (692)*
Achilles tendinitis	3	1	3	4
Anterior knee pain	33	4	28	5
Mechanical back pain	18	12	13	14
Anterior tibial pain	4	3	27	23
Stress fracture tibia	3	1	10	16
Stress fracture foot	5	4	8	7
Stress fracture pubis	1	10	1	7
Stress fracture neck of femur	0	2	2	1

Of 253 medical discharges from the gender-fair cohort, 104 related to overuse injuries. By comparison, the gender-free cohort had 421 medical discharges of which 160 related to such injuries. Details are in Table 2.

Table 3 shows the gender differences in terms of incidence per 10 000.

Among male recruits overuse injury patterns changed little, but female recruits displayed a far greater tendency to overuse injury when trained under gender-free principles. The proportion of female recruits medically discharged because of an overuse injury rose from 4.6% to 11.1%, whereas the proportion of such males remained at under 1.5%. The gender odds ratio for medical discharge following an overuse injury rose from 4.0 (95% CI 2.8 to 5.7) to 7.5 (95% CI 5.8 to 9.7, P=0.001) under the new training regime—despite prior selection.

DISCUSSION

The benefits of physical activity include improved physical fitness and decreased morbidity and mortality. However, there is an optimum level of fitness beyond which the maintenance regimen carries a disproportionate risk of musculoskeletal injury[4–6] with little apparent gain[7,8]. Army applicants enter training with strikingly different pre-enlistment levels of activity, and recruits with poor physical fitness experience a high incidence of injury[9,10].

Regrettably sports activity amongst adolescents has declined in recent years and this helps explain the progressive rise in injury rates amongst military recruits in general, but not the disproportionate rise in female recruits[11]. In an attempt to reduce the risk of injury, the Army expanded its selection tests in 1998 to give a broader picture of an individual's physical ability.

Overuse injuries have long been a feature of military training, and specific risk factors include poor physical fitness, raised body mass index, smoking, age >24 years and excessive running[1,10–15]. In view of the anatomical, physiological and ergonomic differences between the sexes, gender is the single most important factor[16]. Jones showed that 37% of male US Army recruits experienced a lower limb injury during a 12-week basic training course[12] whereas female injury rates may be as high as 60%[1].

There are many reasons why female recruits are at greater risk of injury; the gynaecoid pelvis may produce a relative and transient biomechanical disadvantage when marching, running or carrying weight at the extremes of endurance[17,18]. Hill postulated that a mixed platoon of recruits would tend to march at the male stride (45 cm) rather than the shorter female stride (38 cm) because most of the recruits in the platoon were male[19] and this led to an increased incidence of stress fractures of the pubic ramus amongst females. Under normal circumstances tensile stress in bone is neutralized through contraction of the surrounding musculature to induce compressive force in the bone. This neutralization is impaired when muscles are fatigued, and the unopposed tensile stress then leads to stress fractures[20]. Workers have shown increases in bone mineral density on completion of a 15-week training programme[21]; however, the strengthening of bone under stress entails initial osteoclastic demineralization at 'cutting cones' before trabecular meshwork restructuring and remineralization by osteoblasts[22,23]. The remineralization process lags behind osteoclastic resorption and takes months to complete, so that bone is weakest after 3–4 weeks of continuous training—a phenomenon demonstrated epidemiologically amongst both athletes and military recruits[24–27].

Laubach researched the comparative strength of the sexes and found overlapping curves of normal distribution[28], the 5th percentile for male strength approximating to the 60th percentile for women. Seemingly, however, a woman's muscle can be trained to mimic male muscle, though it takes a long period of time. A US Army study showed that the proportion of female recruits capable of passing strenuous physical tests rose from 29% to 40% after 8 weeks of basic training, yet when a similar group were trained over six months with additional resistance training, the proportion capable of achieving the test scores was as high as 78%[29].

Among recruits to the British Army in 1996, there was evidence of significant muscle fatigue at the end of the first week of training, with mean increases in creatine phosphokinase of 900%[30]. With such evidence of excessive muscle stress at a time when bones are undergoing osteoclastic resorption it is clear why overuse injuries and stress fractures occur. For female recruits the hazard is compounded by differences in bone size, in cortical thickness and in skeletal muscle mass which interact to magnify the stress through bone by 33–39%[31,32].

Table 3 **Gender differences**

	Gender fair cohort					*Gender free cohort*				
	Incidence per 10^4					*Incidence per 10^4*				
Site	*M*	*F*	*OR*	*95% CI*	*P*	*M*	*F*	*OR*	*95% CI*	*P*
Achilles tendinitis	5.3	12.6	2.4	0.3–21.5	>0.5	4.8	57.8	12	3.7–38.7	0.025
Knee pain	58	50.5	0.9	0.3–2.4	>0.5	45	72.3	1.6	0.6–4.1	0.5
Back pain	31	151.7	4.8	2.4–9.3	0.005	21	202.3	9.7	5.2–17.9	0.001
Tibial pain	0.7	37.8	5.4	1.4–20.4	0.1	43	332.4	7.7	4.8–12.3	0.001
Stress fracture tibia	5.3	12.6	2.4	0.3–21.5	>0.5	16	231.2	14.4	7.9–26.1	0.001
Stress fracture foot	8.8	50.5	5.8	1.8–18.4	0.05	13	101.2	7.8	3.35–18.5	0.005
Stress fracture pubis	0.2	126	72	25.2–205	0.001	1.6	101.2	63	20.7–191	0.001
Stress fracture femur	0.01	25.2	288	14.8–5620	0.001	3.2	14.5	4.5	0.5–40.1	0.5
All sites	118	467	4.0	2.8–5.7	0.001	147	1113	7.5	5.8–9.7	0.001

OR=odds ratios

In summary, it is clear that there are differences in muscle physiology, bone architecture and body composition that interact to place women at a substantial disadvantage when training or working to the same output as males. In view of Laubach's overlapping distribution curves for strength, a given amount of work will require more women to reach maximum output and this will result in higher morbidity. Health and safety guidance requires employers to make allowances for these gender differences[33], yet this has been overlooked in the interests of meeting equal opportunities legislation.

The question is, does one area of legislation take precedence over the other? Discrimination is allowed when being male is an 'essential part of the job for reasons of physiology (excluding physical strength and stamina)'[34]. It is not entirely clear which aspects of physiology are referred to, since physical strength and stamina are clearly desirable attributes for physically demanding jobs and 'manual handling equipment' is not a reasonable option, for example, in the close confines of an armoured vehicle. The modern battlefield is as arduous as it has ever been and military training should reflect this.

The answer to this dilemma may lie in the interpretation of Section 51(1)c(ii) of the Sex Discrimination Act, which allows the employer to act in order to protect the woman's health if it is 'necessary to do it in order to comply with a requirement of a relevant statutory provision (within the meaning of Part 1 of the Health and Safety at Work Act)'. The Act amplifies this provision 'relating to pregnancy and other circumstances giving rise to risks specifically affecting women'. Whilst this paper shows that female Army recruits are at substantially greater risk of overuse injuries than their male colleagues, the injuries are not confined to female recruits. Whether Section 51 is sufficient remains to be seen.

The apparent divergence of the legislation places the Army in a difficult position. The Army has a duty to train personnel to an acceptable standard before their release to the 'field army', where they may be deployed on military operations. For many in the specialist trades, initial military training represents the bulk of their general military training, and to dilute the training may lessen its value and endanger personnel who subsequently find themselves on a military operation. On the other hand, it is clear that women are experiencing difficulty with the training in its current format—in short, gender cannot be ignored and rigid adherence to equal opportunities legislation is not benefiting the health of female Army recruits. *The Equal Opportunities Commission Code of Practice*[35] encourages the use of selection tests but states that 'tests should be reviewed regularly to ensure they remain relevant and free from unjustifiable bias'. Improving the validity of the selection tests may help reduce injury rates but at the expense of recruiting, whereas streaming according to ability within the first 2 weeks of the training course—before injury has occurred—would enable targeted remedial training to be given. Selection tests and training methods should now be reviewed in the light of these findings.

Note This paper is based on a report presented at a Bayer Diagnostic Prize meeting on 3 December 1998.

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