The musculoskeletal effect of intense physical training of non-athletic youth corps conscripts

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Abstract

Objective—To determine the musculoskeletal problems associated with high intensity physical exercise among non-athletic youth subjects.

Methods—484 fresh Nigerian graduates participating in the mandatory National Youth Service Corps (NYSC) programme were studied. At the start of the four week intensive physical training which formed part of the orientation course for the programme, the subjects completed a questionnaire designed to determine their previous exercise habit. The physical training consisted of jogging, physical drills, games (soccer and volleyball), and man o'war activities. During the period of physical training, the subjects were instructed to report all ailments to the camp clinic.

Results—Muscular pain/soreness and injuries were major problems associated with the exercise. The lower limbs were most affected and the ankle joint was found to be more injury-prone than other joints.

Conclusions—Most of these graduates were physically unfit and the intense fitness programme produced adverse effects on their physical health. Precamp physical preparation would be desirable.

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Key terms: youth; physical training; physical fitness; myalgia; injuries; questionnaire

It has been reported that improper training techniques, poor equipment and biomechanical/anthropometric abnormalities are the major factors predisposing athletes to injury.^{1,2} Information on injuries sustained during exercise in young athletes may be obtained from many reports.³⁻⁵ Some injuries have been reported among untrained youth subjects.⁶ However, information on the patterns of injury and other musculoskeletal problems such as pain and discomfort among non-athletic youths is not widely available.

In Nigeria, fresh graduates of institutions of higher learning (universities, polytechnics, etc) who are below 30 years of age have to participate in a one-year programme referred to as the National Youth Service Corps (NYSC). At the start of each service year, participants are camped and subjected to a four-week orientation course which features intense physical fitness training among other activities. This study was carried out to determine the effects of the various types of exercise embarked upon

during this course on the musculoskeletal systems of these non-athletic youths in the orientation camp.

Methods

The study was conducted between 3 and 31 November 1992, at the beginning of the 1992/93 service year of the NYSC in Maiduguri in Nigeria's northeastern State of Borno. On entry to the camp, all the participants were given a questionnaire designed to determine their precamp exercise status. Of the total of 508 participants, 484 (332 males and 152 females [26.8 (SD 2.79) years old]) completed and returned the questionnaires and thus formed the subjects for the study.

Camp participants with past injuries or congenital anomalies relating to their musculoskeletal system, camp officials, and those who did not take part in the camp physical training were excluded. The subjects went through the military-type non-graduated physical exercises, drills, games (soccer and volleyball), and man o'war activities for four weeks, like the other camp participants. For the duration of the camp, all participants had similar kit, lived a regimented life, and were fed centrally.

The subjects were routinely interviewed and examined weekly and were also instructed to report any ailment or discomfort to the camp clinic. In the clinic, record was made of any injury or ailment.

A total of 434 musculoskeletal disorders was recorded, 300 from males and 234 from females. Subjects who complained of musculoskeletal pain not due to injury were requested to rate their perceived pain and discomfort on a 10 point scale (table 1).

Results

PAST EXERCISE LEVEL

The result of this study showed that of the 484 subjects, 360 (74%; 220 males and 140 females) had never partaken in organised sports or physical training. Eighty five (17.6%; 81 males and four females) had not participated in physical exercise for at least the past four years. Thirty (6.7%; 22 males and eight females) had

Table 1 10 point scale for rating of perceived pain/discomfort, adapted from Balogun.⁷

0	No pain/discomfort at all
1	Very very mild
2	
3	Very mild
4	
5	Moderate
6	
7	Very uncomfortable
8	
9	Unbearable
10	Excruciating

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Table 2 Pre-camp exercise status of the 484 subjects.

Have not participated in physical exercise for life			Have not participated in physical exercise for the past 4 years			Participate in recreational exercise			University athletes		
Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
220	140	360	81	4	85	22	8	30	9	—	9
45.5%	28.9%	74.4%	16.8%	0.8%	17.6%	4.5%	1.7%	6.2%	1.8%	—	1.8%

participated in leisure exercises, while only nine (1.8%; all males) were (non-elite) University level athletes. This is shown in table 2.

MUSCULAR PAIN

Within the four weeks of physical training, myalgia (66.8%) was significantly more predominant than painful joints (33.2%). The highest recorded incidence of pain was in the first week, while the lowest was recorded in the third and fourth weeks. Generally, the incidence of pain (muscle and joint) was relatively higher in the females [134 (100%)], than in the males [156 (52%)]. Incidence of muscle pain was highest in the calf muscles (46.9%). The incidence of pain in the other muscle groups was as follows: quadriceps 25.2%, hamstrings 25.2%, back extensors 2.7% (tables 3 and 4).

PAINFUL JOINTS

Joint pain was most commonly reported in the ankle (72.2%). Other affected joints included

knee (22.2%), hip (2%), spine (2%), and wrist (1.38%) (table 5).

INJURY

Incidents of joint injury most commonly involved the ankle (37.9%). This was followed by the knee (26.3%). Other joints involved in injury incidents included the hip (1.4%) and the wrist (3.2%). Unlike pain, the greatest number of incidents of injury was recorded in the second week. Males (74.7%) were more injury-prone than females (45.5%) (table 6). Ligaments (65.8%) were more predisposed to injury than tendons (19.9%) and intra-articular injuries (14.3%). This is shown in table 7.

JOINT SWELLING

Females (82.2%) experienced more joint swelling than their male (17.8%) counterparts, with the ankle joint being the most commonly affected. This is shown in table 8.

RATING OF PAIN

The majority (67.3%) of the subjects rated their pain as severe, 29.3% rated it as moderate while only 8.1% rated it as mild (table 9).

Table 3 The influence of adaptation on the weekly distribution of pain in non-athletic youth corporers following intense physical training.

Location of pain	1st Week	2nd Week	3rd Week	4th Week	Total (100%)
Calf	89.0%	8.8%	0.7%	1.5%	136
Hamstrings	84.9%	6.8%	5.5%	2.8%	73
Quadriceps	68.5%	6.8%	16.4%	8.3%	73
Back extensors	7.5%	—	1.5%	—	8
Ankle joint	90.4%	3.8%	5.8%	—	104
Knee joint	76.1%	12.5%	5.1%	6.3%	32
Hip joint	33.3%	66.7%	—	—	3
Wrist joint	—	100%	—	—	2
Spine	100%	—	—	—	3

Table 4 Sex variation in the weekly distribution of muscular pain following intense physical training in non-athletic youth corporers.

Muscle groups	1st Week			2nd Week			3rd Week			4th Week			Per cent of total
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	
Calf	18.3%	23.4%	41.7%	1.7%	2.5%	4.2%	—	0.35%	0.35%	0.35%	0.35%	0.7%	46.9
Hamstrings	13.3%	7.9%	21.2%	0.7%	1.0%	1.7%	1.1%	0.3%	1.4%	0.9%	—	0.9%	25.2
Quadriceps	11.1%	6.2%	17.3%	1.0%	0.7%	1.7%	3.4%	0.7%	4.1%	1.8%	0.3%	2.1%	25.2
Back extensors	0.7%	1.3%	2.0%	—	—	—	0.35%	0.35%	0.7%	—	—	—	2.7
Total	43.4%	38.8%	82.2%	3.4%	4.2%	7.6%	4.85%	1.7%	6.55%	3.05%	0.65%	3.7%	100

Table 5 Sex variation in the weekly distribution of joint pain following intense physical training in non-athletic youth corporers.

Joint	1st Week			2nd Week			3rd Week			4th Week			Grand total	Per cent of total
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total		
Ankle	16.7%	46.8%	65.3%	2.0%	0.7%	2.7%	2.8%	1.4%	4.2%	—	—	—	104	72%
Knee	14.6%	2.8%	17.4%	2.1%	0.9%	2.8%	0.7%	—	0.7%	0.7%	—	1.4%	32	22.2%
Hip	0.7%	—	0.7%	1.3%	—	1.3%	—	—	—	—	—	—	3	2
Wrist	—	—	—	—	1.38%	1.38%	—	—	—	—	—	—	2	1.38%
Spine	0.7%	1.3%	2.0%	—	—	—	—	—	—	—	—	—	3	2%
Total	32.7%	52.7%	84.4%	—	1.98%	7.38%	3.5%	1.4%	4.9%	0.7%	0.7%	1.4%	144	100%

Table 6 Weekly differences in the pattern of injuries in non-athletic youth corporers following intense physical training.

Type of injury	1st Week			2nd Week			3rd Week			4th Week			Grand total	Per cent of total
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total		
Ankle joint	17.5%	3.5%	21.0%	5.3%	2.4%	7.7%	3.2%	1.7%	4.9%	3.6%	0.7%	4.3%	108	37.9%
Knee joint	1.4%	—	1.8%	10.5%	0.7%	11.2%	3.4%	—	3.9%	8.4%	1.0%	9.4%	75	26.3%
Hip joint	—	—	—	1.1%	—	1.1%	0.3%	—	0.3%	—	—	—	4	1.4%
Wrist	—	—	—	0.35%	1.75%	2.1%	—	0.35%	0.35%	0.35%	0.35%	0.7%	9	3.2%
Bruises	5.6%	1.4%	7.0%	11.2%	3.9%	15.1%	4.6%	0.7%	5.3%	1.4%	2.5%	3.9%	89	31.2%
Total	24.5%	5.3%	29.8%	28.4%	8.8%	37.2%	11.9%	2.8%	14.7%	13.7%	4.6%	18.3%	285	100%

Table 7 Structural involvement of injury following intense physical training among non-athletic youth corpsers.

Joint	Tendon			Ligaments			Intra-articular problems			Grand total (100%)
	Male	Female	Total	Male	Female	Total	Male	Female	Total	
Ankle	13.9%	5.5%	19.4%	42.6%	25.9%	68.5%	9.3%	2.8%	12.1%	108
Knee	6.7%	1.3%	8.0%	70.6%	2.7%	73.3%	12.0%	6.7%	18.7%	75
Hip	100%	—	100%	—	—	—	—	—	—	4
Wrist	22.2%	66.7%	88.9%	—	—	—	—	11.1%	11.1%	9

results among University undergraduates. The implication of this is that they have low muscular and cardiorespiratory endurance, and hence should be conditioned gradually to full physical fitness level. Nevertheless they were exposed to the sudden intense exercise, drill and games on arrival in camp. This would explain the high incidence of severe pain among the subjects.

Males are believed to be more physically adventurous in general than females¹⁰; hence subjecting both sexes to the same exercise regime places relatively more stress on the non-athletic female than the more athletic male, thus explaining why females complained of more pain (100%) and less injury (54.5%), unlike the males who recorded more injury (74.7%) and less pain (52%).

The ankle was found to have the highest incidence of pain (72.2%), injury (37.9), and swelling (23.7%). This supports Bass,¹¹ Wilson,¹² and Adedoyin's earlier finding⁶ that the ankle is more predisposed to injury than other joints. However, this is in contrast to the findings of Salmon,¹³ Adeniran and Toriola,³ and Adeniran⁴ who found that injuries to the knee predominated. That the ankle and knee joints should be the prime joints involved on the injury following unaccustomed exercise is hardly surprising. These two joints are both weight bearing structures in nearly all human activities carried out in the erect position.² However, the skilled activities of kicking and ball manipulation (as in soccer) and the effect of ground reaction and shoe types and fitting (as in physical drills and other exercises) appear to have a direct impact on the ankle joint, which is closer to the ground than the knee.

Ekstrand and Gilquist¹⁴ observed that the range of movement and the tensile strength of the ligaments and tendons holding the joints is improved by flexibility training and that

flexible joints are less susceptible to sports injuries. Thus the sudden change in the intensity of work without previous specific flexibility training might be responsible for the high incidence of joint injuries, swelling and pain observed in this study, the ankle being the most affected.

That the lower limbs were more affected by pain and injury is to be expected. This is because a direct relation had been established between the athletes' lower limb muscle strength and susceptibility to injury.¹⁵ Klein and Allman¹⁶ proposed that the muscular strength of the hamstrings, in proportion to the quadriceps in both lower limbs, should be equal to or greater than 69% in order to prevent hamstring injury, especially in contact sports requiring rapid explosive movements such as soccer.² This strength ratio would be unusual in untrained youths. Also, the mechanism of lactic acid buffering and removal is more efficient in trained than untrained athletes.¹⁷ In the latter, lactic acid and other products of metabolism accumulate faster, and fatigue sets in sooner, thus affecting reaction time.¹⁸ The inability of the untrained muscle to relax, coupled with the reduced ability to respond to external stimuli, could have (directly or indirectly) contributed to the high rate of injury observed in this study.

This also explains the finding that the incidence of injury peaked at the second week of training when contact sport (soccer) started. This result is also consistent with other reports^{2 4 5} that the greatest incidence of injury occurs at the beginning of training and practices. However, when considering the causes of injury, it should be noted that shoe selection and use are crucial factors, especially in running and drill.¹⁹

CONCLUSIONS

The following conclusions can be drawn from this study:

- (1) Most undergraduates and new graduates in the camp are physically relatively unfit.
- (2) The fitness programme designed for the camp subjects during the four weeks orientation period produced some adverse effects on their physical health.
- (3) Sudden intense physical training (jogging, drills, calisthenics, contact games, "man o'war") caused discomfort and pain in untrained young people.

Table 8 Sex distribution of joint swelling among non-athletic youth corpsers following intense exercise.

Swollen joints	Sex distribution		Total
	Male	Female	
Ankle	11.1%	65.2%	73.6%
Knee	3.7%	13.3%	17.0%
Hip	1.5%	—	1.5%
Wrist	1.5%	3.7%	5.2%
Total	17.8%	82.2%	100%

Table 9 Rating of perceived pain among non-athletic youth corpsers following intense physical exercise.

Mild			Moderate			Severe		
Male	Female	Total	Male	Female	Total	Male	Female	Total
27	8	25	76	51	127	217	75	292
6.2%	1.9%	8.1%	17.5%	11.8%	29.3%	50%	17%	67.3%

- (4) The effect of the above form of fitness training is more severe in untrained females than males in terms of pain and exhaustion.
- (5) Males are more injury-prone than females under these circumstances.
- (6) Most injuries in non-athletic young people following the type of training described here are confined to the lower limbs.
- (7) The ankle joint is their most vulnerable joint in the current context.
- (8) The rate of injury/pain decreases as the fitness level improves following physical fitness training.
- (9) Physical preparation of the subjects, say for 6–8 weeks before the camp, or a considerable reduction in the severity of the initial phase of the physical training in camp would go a long way in solving or at least reducing these problems.

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