THE FITNESS REQUIREMENTS OF

TRAMPOLINING

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FORWORD

With introduction by:

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FORWORD

Scientific investigation into the various physiological stresses of many sports has led to improved training methods. About a year ago I discussed this with the authors of this paper. It was evident that very little work had been done in the field of trampolining. It seemed evident that there was a need for a detailed study of the sport, both from the cardio-vascular aspect and also from the muscular skills involved.

A research programme was instituted, using a heart rate telemeter and an electromyograph. The heart rate telemeter did not impose much restriction on the subject; but, as a transmitting myograph was not available, the leads connecting the subject to the recording apparatus presented some problems in making the muscular analysis. Nevertheless the authors showed considerable ingenuity in overcoming these difficulties, and have produced a very accurate and worthwhile analysis.

Scientific work for its own sake will hardly help the participants in any sport, and it is important that the results of any experiments are used to improve training methods. The weight training and circuit training exercises that the authors have evolved, as a result of their experimental work, will, I am sure be of the greatest assistance to trampolinists, whatever their level of skill.

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INTRODUCTION

Trampolinists all over the world are striving to raise the status of trampolining, as a competitive sport. All modern sports have been affected by, and have benefited from, the vast amount of biomechanical and physiological research that has taken place over the last few years. The training programmes of top track and field athletes are now based on scientific principles that have been proven and tested; and these principles must also be applied to training for trampolining, if world class performances are to be achieved.

This will be especially important in the future, for the skill of trampolinists, at all levels, has been rising rapidly over the past few years; and in the future the would-be champion must also have powerful legs, back and arms, to obtain maximum height in the bounce; a healthy cardiovascular system to allow him to work hard for a longer period; and mobility to enable him to achieve a tighter tuck or pike position while somersaulting.

These qualities cannot be developed solely on the trampoline, but through a systematic training programme, designed to develop to the full all the attributes required to perform a world class routine. In the future it will be necessary for competing trampolinists to undertake fitness training programmes, in addition to the more obvious skill practices, in his daily routine.

Unless these skills can be developed and perfected during practice sessions, then obviously they cannot be included in a final routine, and it is this problem that is giving coaches much difficulty. For many trampolinists of high potential are incapable of sustained activity on the trampoline. It is the purpose of this study therefore, to investigate how fitness training can assist the specific skills of trampolining.

FITNESS FOR TRAMPOLINING: AND METHODS USED TO INVESTIGATE THIS.

Fitness training is the conditioning of the physiological mechanisms of the body to a degree where they are able to cope with the stresses that a certain situation places on the body as efficiently as possible. When planning a fitness training programme, one must ascertain which physiological processes are placed under stress, and in what manner.

Therefore, this study has reviewed both the cardiovascular and muscular stresses during trampolining, so that a final fitness programme can cater for all aspects of training for trampolining. Several experiments have been performed to investigate the cardiovascular and muscular systems during actual practice sessions; and both the methods and results are explained fully in each section, before drawing conclusions from them. The final fitness training programme is based on these conclusions.

CARDIOVASCULAR RESPONSES WHILE TRAMPOLINING

The Experiment: To investigate pulse responses during trampolining.

The pulse gives a fairly reliable indication of the type of stress that is being placed on the cardiovascular system during exercise. Pulse responses were measured with a pulse telemeter, thus allowing responses to be measured both during and after exercise.

RESULTS

Basic Bouncing.

(Pulse recordings at 10 sec. intervals)

The graph shows that during two minutes of basic bouncing, during which simple stunts were practiced, the pulse reached a plateau and the body reached a steady state of work output. The heart was at a level of 140 per minute; and the body working aerobically. The pulse fell smoothly after exercise. In the above situation the performer did not experience any undue stress.

Fig. I.

Practice of more difficult stunts

(Pulse recordings at 10 sec. intervals).

This situation was produced by the performer doing 3 average bounces, followed by 3 high tuck bounces, repeatedly. During this the pulse did not stabilise, and in fact rose 10 beats after exercise had finished. Even with 3 recovery bounces the performer was continually under stress, and the pulse responses suggest that he was working largely anaerobically. The performers level of skill fell greatly towards the end of the exercise period.

Fig. II.

A 10 Bounce Sequence

(Pulse recordings at 5 sec. intervals)

The first graph is of a sequence performed when cold, and the second one is a sequence performed after a warm up session. By the end of the sequence the pulse had risen to 180 a minute, illustrating the maximum stress that a trampolinist is placed under during a ten bounce routine; much oxygen debt was built up and the pulse recovery graph was spasmodic.

MUSCULAR ACTIVITY WHILE TRAMPOLINING

When planning a training programme it is necessary to discover exactly which muscle groups are working, and in what range, during the activity. This was done firstly through biomechanical observations of trampolining; and confirmed by electromyographic analysis.

Biomechanical Analysis

Muscles Used In Basic Bouncing.

- a) Ankle extensors - Outer range to inner range.
 - b) Knee extensors - Inner range to middle range: excentrically.
- Middle to inner range: concentrically.
 - c) Hip extensors - Inner to middle range: excentrically.
- Middle to inner range: concentrically.
- plus..Arm lifting and lowering action. Mainly flexors.
plus..Trunk flexors and extensors in somersaulting action.
plus..Arm movement in horizontal and frontal plane when twisting.
plus..Trunk rotators in twisting movements.
plus..Forearm flexors and arm extensors in tuck positions.

Electromyographical Analysis

In order to confirm the above analysis, electromyographical readings were taken of the main muscle groups used in trampolining. A single channel instrument was used with surface electrodes.

Sites of Electrodes

Fig. IV

Trace. 1. Gastrocnemius

Basic Bouncing...

Trace. 2. Soleus

Basic Bouncing...

Trace. 3. Medial Vastus. (quads)

Basic Bouncing...

Trace. 4. Abdominals

Basic Bouncing.

Trace. 5. Abdominals

Fwd. Tucked Somersault...

Trace. 6. Abdominals

Back Tucked Somersault...

Trace. 7. Abdominals

Back Piked Somersault...

Trace. 8. Abdominals.

Fwd. Piked Somersault...

The major activity occurs on the actual "push" from the bed..although certain activity is noted slightly prior to the bounce, i.e. in preparation for the coming push.

Well indicated - note activity in regaining balance after somersault.

Not much activity in actual somersault; but considerable on opening out prior to landing.

Trace. 9. Spinal Erector.

Basic Bouncing...

Trace.10. Spinal Erector.

Fwd. Tucked Somersault...

Trace.11. Spinal Erector.

Back Tucked Somersault...

Trace.12. Spinal Erector.

Hollow Back Somersault...

Excessive use on landing.

Note peculiar peak in middle of somersault - less general activity than expected.

Trace. 13. Spinal Erector

Back Piked Somersault...

Trace. 14. Spinal Erector.

Fwd. Piked Somersault...

Much activity.

Trace. 15. Trapezius (3/4)

Back Tucked Somersault...

Trace. 16. Horizontal Arm Extensors

Back Tucked Somersault...

Little activity.

Trace. 17. Biceps.

Fwd. Tucked Somersault...

Trace. 18. Biceps.

Back Tucked Somersault...

Trace. 19. Biceps.

High Bouncing...

Trace. 20. Triceps.

Front Drop...

Sustained activity in push from bed.

- The vertical arrows indicate where on the myograph each particular skill occurs.
- The horizontal line indicates the duration of the noticeable muscular activity in certain skills.
*It must be noticed that although the vertical arrows indicate the actual performance of the skill, e.g. somersault; there is often considerable activity from the final bounce to the skill, and considerable activity from the skill to the landing impact.
- The example below indicates the sensitivity setting on the electromyograph used throughout the study..i.e. one milli-volt.

CONCLUSIONS

Telemeter Experiments

It is evident from the results that a trampolinist is placed under stress:

- (1) During a training session.
- (2) During a ten bounce routine.

Considerable muscle activity being required in take off, control of landing, and maintenance of body positions in flight against centripetal forces. A contributory factor to the stress is the displacement of the abdominal and thoracic contents due to the high gravity forces during landing and take off, causing disruption of the breathing patterns. In general the trampolinist performs anaerobically, and in many ways can be compared to a hundred yards sprinter; the problem being to maintain a high level of performance throughout with a minimum tailing off towards the end of the sequence, in order that the 'difficulty rating' may be kept up.

It is evident therefore that training must be undertaken in order to strengthen the cardiovascular system.

Electromyographic Experiments

Despite a survey of the literature no thorough study of the muscular activities involved in trampolining has been found. Whilst it is possible to estimate which muscles are used in different skills by a biomechanical analysis, it is only with the aid of an electromyograph that an accurate assessment of the muscle actions can be made. Specific exercises to improve the strength and local muscular endurance of these muscles can only be based on this analysis.

Many of the skills are highly complex and so we investigated all the major muscle groups, to give a reliable indication of the overall nature of muscle activity.

From the electromyographic experiments the following points emerge.

- (1) There is massive activity in take off, not only in the legs, but also in the arms, shoulders and back regions.
- (2) Massive activity in landing; not only in absorbing kinetic energy, but also in correcting balance of the body after movements in the air.
- (3) Much abdominal activity in somersaulting; in particular prolonged activity during the somersault to assist in holding position, and strong action in lifting the legs in a tucked back somersault.
- (4) Spinal extensors are used strongly in many types of somersaults; particularly in extension after front and back somersaults.
- (5) Activity in arms and shoulders during somersaults, while holding knees into the chest.

*Note

The subject although competent, did not perform at a very high standard; for he was somewhat hampered by the leads connecting him to the myograph. It is possible that a more skilled performer would show a) more activity during somersaulting, through holding better tuck and pike positions; and b) less activity immediately prior to and after somersaulting, due to more balanced and controlled overall flight patterns.