GET FIT FOR BADMINTON

A Practical Guide to Training for Players and Coaches

Jake Downey Dip. PE., Dip. Ed., M. Ed.
and David Brodie B. Ed., M. Sc., M.I. Biol.

To Megan, Jo-Anne and Tom

First published in Great Britain
by Pelham Books Ltd
44 Bedford Square
London WC1B 3DU 1980

Illustrations by Jake Downey and Lindsay Harris

ISBN 0 7207 1233 5

Contents

Acknowledgements

The authors wish to acknowledge gratefully the proof-reading by and useful comments from Pandy Brodie, Dr John Humphreys, Jenny Conlon, Dr Peter Ferguson, John Woolhouse, Ollie Cussen, Tom Bowker and Barry Smith and Ruth Baldwin of Pelham Books. Thanks are also due to June Miller for compiling the index and to Lindsay Harris for the figure drawings.
The twelve-minute tests for men and women in Chapter 4 are copy-right Kenneth H. Cooper, MD, MPH, and are reproduced by permission of the original publisher, M. Evans and Company, Inc., New York, NY 10017.
The interval-training charts in Chapter 7 are reproduced in modified form, from *The Physiological Basis of PE and Athletics* by D.K. Mathews and E.L. Fox, published by W.B. Saunders Company, Philadelphia.

Foreword

Twenty years ago training for badminton was rare. Occasionally one would run a bit, do some exercises and the odd fanatic started (but soon stopped) doing a circuit. Seven years or so ago training started to become much more common and is now very much the rule rather than the exception. Yet still no one has explained, authoritatively, why or how we should train for badminton. This book sets out to fill the gap.

Jake Downey has for long been one of our more thoughtful and ana-lytical coaches and has with David Brodie, a leading sports scientist from Carnegie School, Leeds Polytechnic, produced an excellent book. You do not have to be a physiologist or an expert coach or player to read and understand it, for it is written in simple language. The one requirement is an interest in preparing and training for badminton more knowledgeably. Who knows, a better understanding of the reasoning behind the training may even make it easier to stick at those schedules rather than just starting them.
I recommend this book to all players and coaches.

JOHN T. WOOLHOUSE
Chairman
Coaching and Technical Committee
Badminton Association of England

Introduction

Many badminton players enjoy the social and recreational aspects of the game and play `in order to keep fit'. Such players often find that winning also provides great satisfaction and added enjoyment. They come to realize that the possibility of winning is increased if play is based upon an appropriate level of fitness. This, however, results in a certain conflict: do we play to get fit or do we get fit to play? The answer usually depends on the standard of play one wishes to attain; for most people, at whatever level they play, want to become better players.

Fitness training provides one method for improving performance. There are other means of improving performance, skills practice being the most obvious. However, though we appreciate that there is a close connection between levels of skill and fitness, this book has been written to provide the knowledge about training irrespective of the player's level of skill.

There are many players who train regularly by running and doing simple circuits and flexibility exercises. This sort of player judges his fitness by how he feels and how he looks. Thus, if he feels fit and is springy and sharp in his movements, and looks lean, with good muscular definition, then he is happy. Such an approach is satisfactory up to a point but does not guarantee that the most efficient training methods and methods of evaluation are used. Our intention is to be more specific and to encourage the player and the coach to design training programmes based upon the sound scientific principles which we outline here. These principles will provide a framework for any form of training adopted by the player and enable him to assess the relative value of his training programme.

Much work has yet to be done in badminton, particularly on the pattern and work demands of the game. It is hoped that this book will encourage others to seek greater knowledge of the game and thus provide a further insight into training requirements. The authors have adopted a scientific approach to the subject and have extracted and applied training methodology from a variety of other sports. This book aims to bring existing knowledge and apply it directly for the benefit of the game as a whole.

We are well aware that the technical skills of badminton are of relatively more importance than the level of fitness. We are also aware that skill breaks down under fatigue. Increased fitness will delay the onset of fatigue and thus enable the player to maintain levels of skill for longer periods of time. Inevitably only the reader will be the best judge of whether the extra commitment to fitness training is worth the increased satisfaction and improved standard of play. We believe that he will discover it to be worth while.

HOW TO USE THE BOOK

The book is divided up into four sections. Parts One and Two explain the theoretical aspects of fitness and training. Parts Three and Four discuss the practical aspects of how to get fit. It would be easier for the reader if he could plunge straight into Parts Three and Four, but to do so without knowing the effects of certain forms of training could be of limited value. Some understanding of fitness is necessary to obtain the most benefit from any training and so it is important to read Parts One and Two.

Wherever possible we have tried to avoid using technical language and hope that we have made the theory sufficiently interesting to capture your attention. Where a technical term has not been explained in the text then refer to the Glossary of Terms at the end of the book (see p. 117).

Read Part One to gain a general idea of what is involved in fitness with particular reference to badminton players. Part Two requires more consideration and should be studied with care, for it provides the rationale for different sorts of training. Chapter 3 tells you how fitness is divided so that you can read Chapter 4 and find out how to test your fitness level. We consider that Chapter 5 is of key importance. It provides the scientific basis for the principles of training found in Chapter 6. These make it possible to devise any sound training programme.

Part Three is all about training to get fit. Read Chapter 7 to learn how the systems which supply energy to the body can be developed by different forms of interval-training. Chapters 8 and 9 provide numerous examples of how interval-training methods can be applied both off and on the court. Chapters 10 and 11 provide further information about flexibility and warm-up, strength and power. After reading these you should be able to choose exercises from the range included and incorporate them into your own training programme.

You should read Part Four before actually commencing training. This is especially important for coaches who plan specific programmes for players. Chapter 12 provides a comprehensive account of programme planning and leads into Chapter 13 which looks at model training schedules for different levels of play. These models should help you to devise your personal training programme. Once you have become familiar with these aspects of fitness, the book can be used for reference to advise and guide you in all matters concerning training for badminton.

PART ONE

The Nature of Badminton

1

The Requirements of the Game

In order to write a book on fitness-training and to recommend appropriate and realistic training methods it is necessary to be clear about the nature of the game. The greater one's understanding of the game and its demands, the more accurately can training programmes be devised and the more effective will be the training.

It is very easy to devise training schedules in accordance with general principles of training. The difficulties are to make the training programme appropriate to the game of badminton and, more specifically, to the player being coached. For example, the training schedule of a highly skilled but relatively unfit player would be very different from that of a less skilled but extremely fit player. The coach and the player must have clear indications of their targets with respect to training. Hence the requirements of higher standards of play are analysed and once these are known, particularly from the point of view of work demands, then realistic training programmes can be prepared.

Simple observation provides us with much information about the work demands. From this we can learn that the game requires the player to perform work of the nature of sprints, stops and starts, jumps, leaps, lunges, rapid changes of direction, twists and turns and a variety of strokes. All this work goes on for a period of time and eventually leads to a certain degree of fatigue. Our concern is not so much with these move-ments as with the work demands of these movements on the player. We want to know how the work affects his body: his heart and lungs, muscles, blood, joints and all the other components of the machine that he is when he performs work. Our main concern is to examine the effect of work on the machine and to devise the means to make that machine more efficient. The greater the efficiency the greater the work load it will be able to take on.

Unless we can gain accurate information of this sort, fundamental errors may occur. For example, a training programme for a county player could include several three-mile runs in a week. It may be that this player does not enjoy running and therefore takes it fairly gently and runs at a jogging pace.

jogging pace. This activity may only have a limited training effect and, as we shall see later, develops an energy system which is rarely used in actual competitive play. It is how to collect information that is the difficulty. Scientific enquiry involves making accurate measurements in realistic conditions. Tournament play is the best situation for investigation but unfortunately this is one occasion when such interference in the game would not be tolerated. However, there are a variety of methods for collecting information which do not interfere with the play. Some of these are explained below.

METHODS OF MEASUREMENT

The method of measurement depends largely on the sort of information to be obtained. The work demands of the game can be measured with various pieces of physiological equipment.

Figure 1.1 shows one of these in use and from this an estimate of the energy expenditure can be made. Results from this equipment have shown that an international bad-minton-player maintains an average level of about 10 kilocalories per minute throughout a 40-minute game with the level going as high as 13.5 kilocalories per minute during periods of intense activity. This makes the game of badminton equivalent in energy expenditure to activities such as soccer, circuit-training and rowing. Together with the knowledge that badminton is a game of the stop/start variety, this information may help us to design the correct form of training.

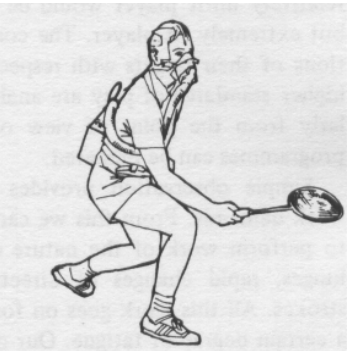


Figure 1.1 Equipment to measure energy expenditure during badminton play

As can be seen from Figure 1.1, the fact that the player needs to wear a face-mask and carry a small machine on his back is bound to limit his performance. It is possible to substitute this with much smaller equipment which transmits the heart beat to a receiver on the side of the court, although some accuracy is lost thereby. Here the instrument the player wears is only the size of a cigarette packet (see Figure 1.2), and thus interferes very little with the game.

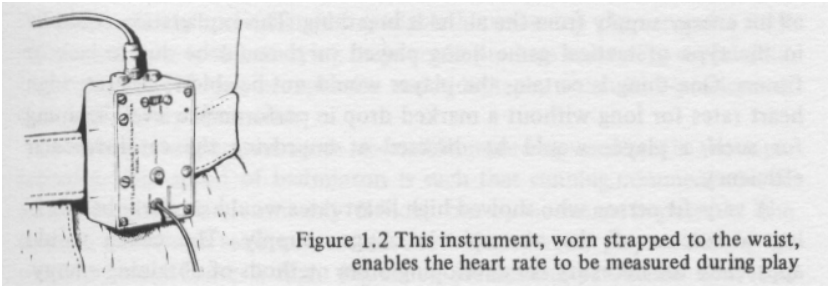
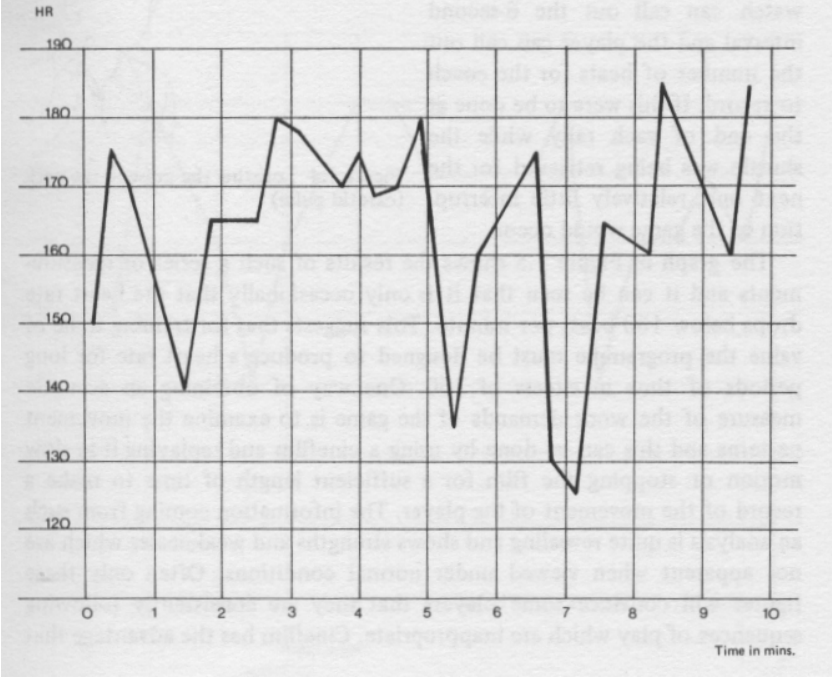


Figure 1.2 This instrument, worn strapped to the waist, enables the heart rate to be measured during play

The recordings of heart rates obtained give a very good indication of the work demands of the game. The graph shown in Figure 1.3 shows the changes in heart rate during a game and the quite high rates experienced. These high levels of heart rate are to some extent associated with how energy is provided for the working muscles. An unfit individual who consistently showed very high heart rates would be unlikely to be getting

Figure 1.3 The changes in heart rate during a game



all his energy supply from the air he is breathing. The explanation could lie in the type of tactical game being played or it could be due to lack of fitness. One thing is certain, the player would not be able to tolerate high heart rates for long without a marked drop in performance level. Training for such a player would be directed at improving the cardiovascular efficiency.

A very fit person who showed high heart rates would similarly be work-ing in excess of the atmospheric oxygen supply. The coach would appreciate the necessity for developing other methods of obtaining energy. The information could then be used directly by the coach to train the correct energy system by a series of intense activities of short duration (below one minute) with adequate rest periods in between.

Although it is accepted that few coaches will have access to equipment that can transmit heart beats, it is possible to simplify the test by teaching the players to record their own. This can be done by locating the pulse beat in the neck (carotid pulse) as in Figure 1.4 and counting the number of beats in 6 seconds. This figure multiplied by 10 is the heart rate per minute. The coach using a stop watch can call out the 6-second interval and the player can call out the number of beats for the coach to record. If this were to be done at the end of each rally while the shuttle was being retrieved for the next one, relatively little interruption of the game would occur.

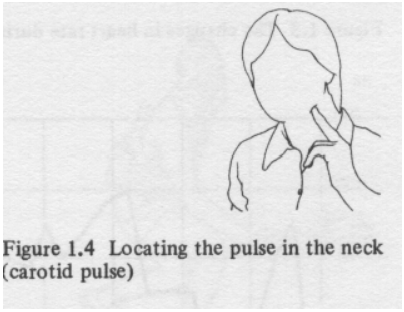


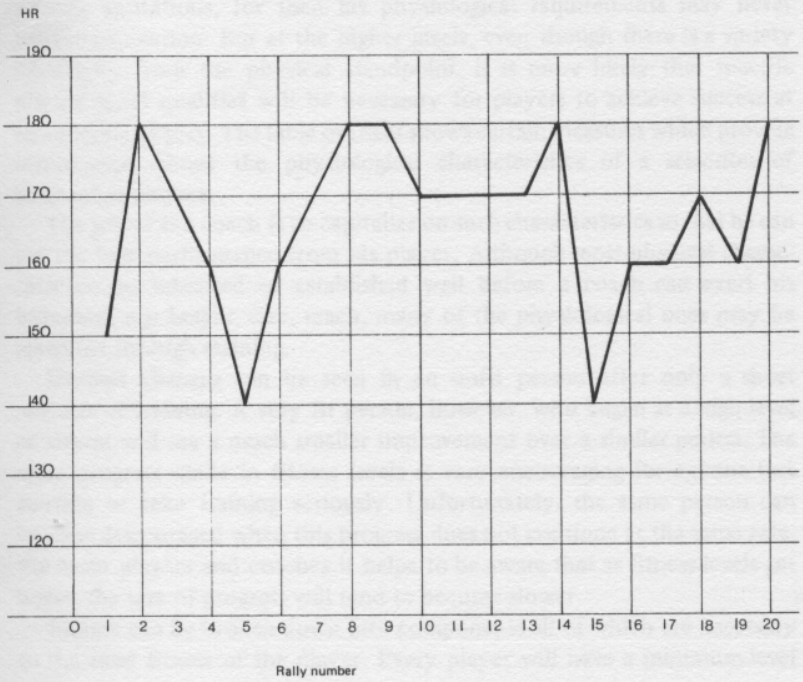
Figure 1.4 Locating the pulse in the neck (carotid pulse)

The graph in Figure 1.5 shows the results of such a series of measure-ments and it can be seen that it is only occasionally that the heart rate drops below 160 beats per minute. This suggests that for training to be of value the programme must be designed to produce a heart rate for long periods of time in excess of 160. One way of obtaining an accurate measure of the work demands of the game is to examine the movement patterns and this can be done by using a cinefilm and replaying it in slow motion or stopping the film for a sufficient length of time to make a record of the movement of the player. The information coming from such an analysis is quite revealing and shows strengths and weaknesses which are not apparent when viewed under normal conditions. Often only these figures will convince some players that they are consistently following sequences of play which are inappropriate. Cinefilm has the advantage that

there are already some matches available between top players and a little effort and time spend studying these could produce some very useful data. Unfortunately filming is expensive and videotape, which is re-usable, may be a satisfactory alternative.

An even cheaper and more accessible recording medium is the tape-recorder. The speed of badminton is such that running commentaries of stroke sequences are extremely difficult but by no means impossible. The analysis of stroke sequences could show that certain players follow set routines which have a high degree of predictability. Armed with this knowledge it should be possible to develop skills to upset the sequences and thus play more successfully. This is where the skill training under pressure (see Chapter 9) would not only develop levels of fitness but could be conditioned to reduce the effectiveness of an opponent. For example, an opponent who has been filmed or taped may be seen, after analysis, to

Figure 1.5 Graph based on a series of regular carotid (neck) pulse measurements to show that heart rate rarely drops below 160 beats per minute during play



be making 85 per cent of his winners from a smash to the backhand midcourt. Apart from being aware of this fact, and thus being prepared, the challenger could be conditioned under pressure to be able to cope with that shot and to modify the pace of his game accordingly. This does not imply a slowing of pace, but if the opponent's rhythm is upset, then changes of pace which are within the player's fitness capabilities could be very successful.

The following results were taken from slow-motion videotape record-ings of international players and give a much clearer indication of the game of badminton:

The average distance run during each rally was 12.2 metres with a range of 1-45 metres.
The average number of hits per rally was 6 with a range of 1-27.
The average playing time per rally was 6.7 seconds with a rest time between rallies of 9.9 seconds.

These results if properly used allow the coach and player to establish a more precise training programme.

2

The Requirements of the Player

Now we have some idea of the requirements of the game and the work demands of the player, we can attend to the player and examine what he is required to do to meet those demands.

Whereas in a sport such as basketball it is a basic requirement to be tall, in badminton players come in many shapes and sizes. There is such a high element of skill in the game that it can accommodate people of varying physical proportions and physiological efficiencies and many people take to badminton simply because they find that their enjoyment of the game is not limited by their particular physical build. This is quite acceptable up to a point for the recreational player who has no higher playing aspirations, for then his physiological requirements may never need modification. But at the higher levels, even though there is a variety of players from the physical standpoint, it is more likely that specific physiological qualities will be necessary for players to achieve success at these levels of play. The table overleaf shows certain measures which provide information about the physiological characteristics of a selection of badminton-players.

The job of the coach is to capitalize on such characteristics so that he can get the best performance from his player. Although most physical charac-teristics are inherited or established well before a coach can exert his influence, e.g. height, size, reach, many of the physiological ones may be modified through training.

Distinct changes can be seen in an unfit person after only a short amount of training. A very fit person, however, who began at a high level of fitness will see a much smaller improvement over a similar period. The early progress made in fitness levels is very encouraging for anyone just starting to take training seriously. Unfortunately, the same person can become discouraged when this progress does not continue at the same rate. For both players and coaches it helps to be aware that as fitness levels get higher the rate of progress will tend to become slower.

Fitness can be broken down into components all of which are necessary to the total fitness of the player. Every player will have a minimum level

Characteristics of Selected Badminton-Players

Team	*England Senior*	*England Senior*	*England Under 18*	*England Under 18*	*England Under 16*	*England Under 16*	*England Under 15*	*England Under 15*
Male/Female	*Male*	*Male*	*Male*	*Male*	*Female*	*Female*	*Female*	*Female*
Bodily measures								
Weight (kg)	74.5	80.6	72.1	69.0	54.6	51.9	50.6	53.5
Height (cm)	171.6	177.2	176.0	183.2	164.3	164.0	157.2	156.1
Skin fat (mm)	9.4	11.6	9.2	9.0	11.8	9.8	10.5	16.6
Calf circumference (cm)	38.2	38.6	36.6	36.8	36.3	35.8	33.2	33.9
Biceps circumference (cm)	29.5	31.0	30.7	28.3	23.9	22.9	23.5	27.7
Strength measures								
Grip strength (kg)	53	49	44	45	37	27	25	28
Back strength (kg)	110	119	145	113	71	65	50	82
Leg strength (kg)	184	140	190	196	72	84	48	65
Performance measures								
Jump height (in)	23.5	20.0	22.0	18.0	19.0	18.0	17.0	16.0
Chins	8	6	11	1	0	1	0	2
Shuttle-run (secs)	22.2	25.1	23.8	24.8	25.0	25.0	26.0	26.6
Lung measures								
Volume (l)	6.95	6.35	5.40	7.80	4.30	4.00	4.00	3.90
Power (l)	5.75	5.25	4.50	6.30	3.90	3.90	3.30	3.70
Efficiency (%)	83	83	83	81	91	97	82	95
Endurance measures								
Aerobic capacity (l/min)	3.33	4.06	3.20	3.30	2.20	2.20	2.90	2.70

for each of these components, though few will have developed each one to its full potential. It is the task of each aspiring champion to examine these requirements, to assess the strengths and weaknesses and to correct and improve them where necessary. The following section provides a detailed explanation of the various aspects of fitness.

PART TWO

The Nature of Fitness

3

What is Fitness?

Fitness is an ambiguous concept. It is quite possible to feel fit when a few scientific tests would prove that one was far from fit in physiological terms. A player may go on court for a match knowing without doubt that by all standards of measurable fitness he is the fittest man in the tourna-ment and yet feel quite unfit. It is also possible to be very fit for one sport, e.g. football, but when swimming a hundred metres quickly get out of breath and feel quite tired. These few examples serve to confirm that there is no one ultimate state of fitness.
Any discussion of total fitness should focus on the question, `Fit for what?' Consequently, any training for fitness must relate specifically to one activity. Our intention is to examine fitness for badminton purely from the physiological aspect. Hence our concern is with the demands of the game described in the previous chapter.

THE COMPONENTS OF FITNESS

The player must develop a number of components in his fitness training. These are:

1 Agility
2 Local muscular endurance
3 Cardiovascular and respiratory endurance
4 Strength
5 Power
6 Speed
7 Flexibility
8 Maintenance of appropriate body weight

Each will be defined and examined in turn.

Agility

This is the ability to change direction accurately and quickly while moving rapidly. This is obviously necessary for successful badminton play and often differentiates between two equally skilled players one of whom is able and the other unable to

return a difficult shot. Returning almost certain winners is the prerogative of the player with a high level of agility. The sudden changes of direction, the twisting and rapid turning which are the hallmarks of quality players are simply examples of agility.

Local muscular endurance

This is the ability to use the localized muscle groups repetitively without undue fatigue. As movements have to be very controlled in badminton, the play will involve using localized muscle groups of the wrist, lower arm and shoulder. However, the game does not require one single movement as in golf, for example, where there is an adequate interval before the next swing. The same, and other similar movements have to be repeated many hundreds of times in a match. The muscles, therefore, require a high level of endurance which the player must develop by appropriate pressure practices and non-related activities.

Cardiovascular and respiratory endurance

This is the capacity of the player to keep up demanding activity over long periods of time, particularly when large muscle groups are involved. The name for this component could be heart and lung endurance, because it is involved with the transportation of energy to the working muscles. As badminton is a game which demands a considerable amount of running and jumping it will need a constant supply of energy to these heavily worked muscles. This will only come about if the heart and lungs are capable of working efficiently for long periods of time.

Strength

Strength can be divided into two sub-categories:

1 Dynamic strength
2 Static strength

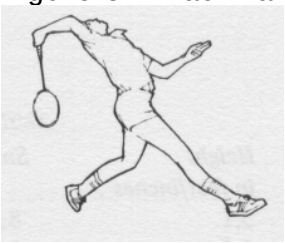
Dynamic strength is the player's ability to lift or move an object. Static strength is the force that can be exerted for a brief period of time against a relatively immovable object. Neither of these has much place in the actual game of badminton, but may be developed to improve another fitness component, that of power.

Power

This is the capacity to release the maximum force in the shortest possible time. A powerful player is not only strong but generates the force quickly. This is illustrated by a powerful smash or the power of the legs when

jumping backwards to smash an attack clear from the backhand rearcourt.

Figure 3.1 Backward jump smash



Speed

This is simply the ability to run fast and, although essential for top quality play, it may not be as critical as the ability to accelerate quickly. The badminton-player has to change direction or start from a stationary position so often that the ability to reach a high speed over a few strides may be more important than a general ability to run quickly. In a 100-metre race the highest speed is not reached until between 40 and 60 metres from the start, so it can be seen that this performance would have little value in the game of badminton. It is true, of course, that a fast runner is also likely to be fast over one or two metres and this is largely because the physiological characteristics suited to high-speed running are the same as for rapid acceleration.

Flexibility

This is the ability to move the trunk and limbs through a wide range of positions. A flexible player has an advantage over a less flexible player, for the ability to return a shuttle when caught off-balance or at full stretch depends on good flexibility.

Maintenance of correct body proportions

This component has been included because incorrect body proportions which are due to excess fat deposits can influence so many other aspects of fitness. An extra pound of fat, for example, is considered to add about a mile of blood vessels to the system which is bound to present extra work for the heart. As fat makes no contribution to movement it must be replaced by the more valuable tissue such as muscle. Extra weight in the form of fat can effect speed, agility and flexibility.

Certain aspects of nutrition will be considered later in Chapter 12 but attention to this is essential for all serious players. Tables have been published showing desirable weights for given heights, but with sporting populations who tend to have a predominance of the very dense and there-fore very heavy muscular tissue, these figures may give an underestimate of the actual weight. The following table gives a general picture.

Body-Weight Table
(in stones/lb)

MEN

Height in feet/inches	*Small frame*	*Medium frame*	*Large frame*
5.1	8.0 – 8.8	8.6 – 9.3	9.0 –10.1
5.2	8.3 – 8.12	8.9 – 9.7	9.3 –10.4
5.3	8.6 – 9.0	8.12– 9.10	9.6 –10.8
5.4	8.9 – 9.3	9.1 – 9.13	9.9 –10.12
5.5	8.12– 9.7	9.4 –10.3	9.12–11.2
5.6	9.2 – 9.11	9.8 –10.7	10.2 –11.7
5.7	9.6 –10.1	9.12–10.12	10.7 –11.12
5.8	9.10–10.5	10.2 –11.2	10.11–12.2
5.9	10.0 –10.10	10.6 –11.6	11.1 –12.6
5.10	10.4 –11.0	10.10–11.11	11.5 –12.11
5.11	10.8 –11.4	11.0 –12.2	11.10–13.2
6.0	10.12–11.8	11.4 –12.7	12.0 –13.7
6.1	11.2 –11.13	11.8 –12.12	12.5 –13.12
6.2	11.6 –12.3	11.13–13.3	12.10–14.3
6.3	11.10–12.7	12.4 –13.8	13.0 –14.8

WOMEN

Height in feet/inches	*Small frame*	*Medium frame*	*Large frame*
4.8	6.8 – 7.0	6.12– 7.9	7.6 – 8.7
4.9	6.10– 7.3	7.0 – 7.12	7.8 – 8.10
4.10	6.12– 7.6	7.3 – 8.1	7.11– 8.13
4.11	7.1 – 7.9	7.6 – 8.4	8.0 – 9.2
5.0	7.4 – 7.12	7.9 – 8.7	8.3 – 9.5
5.1	7.7 – 8.1	7.12– 8.10	8.6 – 9.8
5.2	7.10– 8.4	8.1 – 9.0	8.9 – 9.12
5.3	7.13– 8.7	8.4 – 9.4	8.13–10.2
5.4	8.2 – 8.11	8.8 – 9.9	9.3 –10.6
5.5	8.6 – 9.1	8.12– 9.13	9.7 –10.10
5.6	8.10– 9.5	9.2 –10.3	9.11–11.0
5.7	9.0 – 9.9	9.6 –10.7	10.1 –11.4
5.8	9.4 –10.0	9.10–10.11	10.5 –11.9
5.9	9.8 –10.4	10.0 –11.1	10.9 –12.0
5.10	9.12–10.8	10.4 –11.5	10.13–12.5

4

How to Test your Fitness

Once the components of fitness have been identified we must know how to measure them. It is obvious that any evaluation of training will depend on the measure of progress shown from one level of fitness to another. For that reason it is sensible to measure the level of fitness prior to the training programme.

The most effective method of evaluating the effects of training is by performance in play. Ultimately, this is what really matters. Playing performance, however, is sometimes difficult to measure for it is influenced by many other factors such as personal skills level and the ability of the opponent. In view of this it is helpful to have an indication of levels of fitness which are independent of the game. It is also necessary to isolate each component and to establish the player's relative strengths and weaknesses and check if training has changed these.

Fitness can be evaluated by many tests and so we have selected the following for ease of administration and simplicity of equipment. These can be carried out in a hall or gymnasium lacking in equipment and are designed to measure each component of fitness. When evaluating these components it is important to have an adequate rest between each test. The order of the tests must be carefully arranged to prevent fatigue in any one component especially if all the tests are to be completed in one session. It is essential that players do not undertake physical work if there is any suspicion of illness or disease. Refer to the section on medical advice on page 99.

FITNESS TESTING PROCEDURE

Before commencing the tests, make out a fitness test card to record the results, as shown overleaf. Write in the date and then record the result obtained for each test. Regular testing with a record of results will provide an accurate indication of fitness progress and confirm or question the value of the training programme.

Fitness Test Record Card

Test	*Component*	*Units Score*	*Date 5.7.69 Test Score*	*Date 5.12.69 Test Score*	*Comments*
Agility run	agility	time in seconds			
Sit-ups	local muscular endurance (abdominals)	number in 60 seconds			
Squat-thrust	local muscular endurance (legs)	number in 60 seconds			
Net-smash	local muscular endurance (arm)	number in 30 seconds			
12-minute run	cardiovascular endurance	distance in miles			
Step test	cardiovascular endurance	step test index			
Chins	strength	maximum number			
Dips	strength	maximum number			
Press-ups	strength	maximum number			
Sargent-jump	leg-power	height in inches			
50-yard run	speed	time in seconds			
Shuttle-run	speed	time in seconds			
Touch-toes	flexibility	inches			
Spine extension	flexibility	inches			
Weight	correct body weight	kilograms			

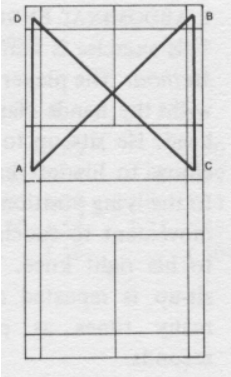
TESTING THE COMPONENTS

Agility

This test involves a timed run over a clearly defined course on one half of the badminton court.

The player carries a racket and is required to touch each corner of the half court. He starts from A and sprints to B, C and D and returns to A to repeat the course a second time. His time for the two circuits is recorded to the nearest one-tenth second.

Figure 4.1 Agility test



Local muscular endurance

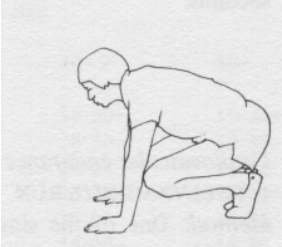
This varies according to the muscle groups to be tested. Three tests are described, one for each of the local muscle groups, i.e. arms, legs and abdominals. Usually, to give a clear indication of endurance, unlimited time should be allowed to complete the activity. As this would prolong the testing session, a time limit has been imposed. Although a time will tend to introduce an element of speed into the test it will not be sufficient to reduce the effectiveness of the test for local muscular endurance.

1 LEG ENDURANCE

This exercise is known as a 'squat--thrust'.

Method: The player starts in the press-up position with the legs fully extended. The hands re-main fixed throughout the exer-cise. On the command `Go' the player springs forward to land with his knees level with his arms and then jumps back to return his legs to the fully extended position. This is one squat-thrust. He repeats this continuously for as many times as possible within the 60 seconds. It is advisable to have a second person counting and checking that the movement is completed properly.

Figure 4.2 Squat-thrust



2 ABDOMINAL ENDURANCE

This exercise is known as a `sit-up'.

Method: The player lies on his back with the hands clasped behind his head. He sits up to touch his right elbow to his left knee and returns to the lying position. He repeats the movement to touch his left elbow to his right knee. This alternating sit-up is repeated continuously as many times as possible in 60 seconds.

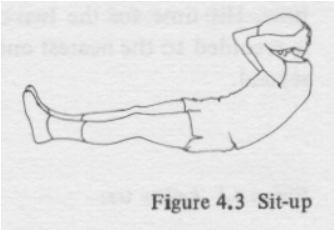


Figure 4.3 Sit-up

3 ARM ENDURANCE

This exercise is the 'net-smash'.

Method: The player adopts a net attack position. The arm is flexed at right-angles, racket-head pointing upwards ready to hit down above the net. The player performs a hitting action which involves a rapid extension of the arm and a return to the 90-degree flexed position on each hit. He repeats this as many times as possible in 30 seconds.

Figure 4.4 Net-smash

Cardiovascular endurance

1 TWELVE-MINUTE RUN

Method: One of the simplest tests to administer if suitable facilities are available is to measure the distance run in 12 minutes. An athletics track or clearly marked running field is ideal. Distances can also be measured on any flat surface of measurable length or overall size. The advantage of the 12-minute run is that fitness standards have been published as opposite.

Twelve-Minute Test for Menu`
(Distances in miles covered in 12 minutes)

Fitness category		*Age*			
		Under 30	30–9	40–9	50+
I	Very poor	<1.0	<0.95	<0.85	<0.80
II	Poor	1.0 –1.24	.95–1.14	.85–1.04	.80– .99
III	Fair	1.25–1.49	1.15–1.39	1.05–1.29	1.0 –1.24
IV	Good	1.50–1.74	1.40–1.64	1.30–1.54	1.25–1.49
V	Excellent	1.75+	1.65+	1.55+	1.50+

< Means less than

Twelve-Minute Test for Women*
(Distances in miles covered in 12 minutes)

Fitness category		*Age*			
		Under 30	30–9	40–9	50+
I	Very poor	<0.95	<0.85	<0.75	<0.65
II	Poor	.95–1.14	.85–1.04	.75– .94	.65– .84
III	Fair	1.15–1.34	1.05–1.24	.95–1.14	.85–1.04
IV	Good	1.35–1.64	1.25–1.54	1.15–1.44	1.05–1.34
V	Excellent	1.65+	1.55+	1.45+	1.35+

2 THE 1.5-MILE TEST

Method: Run a distance of 1.5 miles and record the time taken. Check for your fitness level on the table below. The test can be completed on a run-ning track or measured quite easily on the road using the car mileometer.

1.5-Mile test*
(Running time in minutes for 1.5-mile distance)

Fitness category		*Age*			
		Under 30	30–9	40–9	50+
I	Very poor	16:30+	17:30+	18:30+	19:30+
II	Poor	16:30–14:31	17:30–15:31	18:30–16:31	19:30–17:01
III	Fair	14:30–12:01	15:30–13:01	16:30–14:01	17:00–14:31
IV	Good	12:00–10:16	13:00–11:01	14:00–11:31	14:30–12:01
V	Excellent	<10:15	<11:00	<11:30	<12:00

*K Cooper, *The New Aerobics*, Bantam Books (London, 1970).

3 HARVARD STEP-TEST INDEX

Method: This is an alternative method, devised at Harvard University, which requires minimal equipment and is based on the fact that a person with good cardiovascular endurance will return more quickly to a slower heart rate after exercise than will a person with poor cardiovascular endurance. The subject steps up and down, on and off a chair or bench for 5 minutes at a rate of 30 steps per minute. Ideally a bench 20 inches high for men and 16 inches high for women is used. This height is not important providing the height is the same on each testing occasion. At the end of the period of exercise the player sits down and waits for exactly one minute. Immediately he counts his heart beats for a period of exactly 30 seconds by placing his fingers on the carotid pulse in the neck as shown in Figure 1.4 on page 20. The number of heart beats is put into the following formula and the test score is calculated.

$$\frac{\text{number of seconds of exercise} \times 100}{5.5 \times \text{number of heart beats in 30 seconds}}$$

If the player fails to maintain the stepping rate of 30 steps per minute he sits down and records the I minute recovery from then. In this case it is important to have noted the number of seconds of the exercise that was completed before stopping.

To ensure that any later test would involve an identical work load, the stepping rate must be kept constant at 30 steps per minute (up and down in rhythm 30 times per minute). One of the simplest ways of doing this is to use a partner to call out the stepping rate. A further standardization procedure is to make certain that the legs are fully extended at the knee-joint when standing on the chair or bench. The following table pro-vides a rough guide for standards of performance after a period of training.

Performance	*Step test score*
good	81 and above
average	50-80
poor	49 and below

Examples

1 A player who stepped up and down for 5 minutes (300 seconds) and

had a heart-beat count of 50 in the timed period of 30 seconds would score:

$$\frac{300 \times 100}{5.5 \times 50} = 109 \text{ (a good score)}$$

2 A player who only managed to step up and down for 3 minutes and 15 seconds (195 seconds) and had a heart-beat count of 73 after the timed period would score:

$$\frac{195 \times 100}{5.5 \times 73} = 48 \text{ (a poor score)}$$

Strength
Strength is usually measured with a special machine called a dynanometer. However, as these machines are not readily available, the following methods can be used.

1 GRIP STRENGTH
Method: One simple way to test grip strength is to grasp a pair of bath-room scales to give a reading on the dial.

2 ARM STRENGTH
This can be measured in several ways.

Method 1: Pull-ups. Count the num-ber of pull-ups (chins) completed by lifting the body weight up to a high bar. Start with extended arms, pull up to chin the bar and extend the arms again. This is one pull-up.

Note: The bar should be over-grasped with the palms facing forwards.

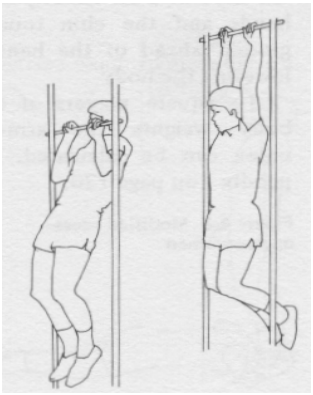


Figure 4.5 Pull-up

Method 2: Dips. Rest supported between a pair of parallel bars. Flex the arms to 90 degrees and straighten them. This is one dip. Count the maximum number you can perform.

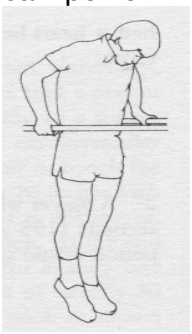


Figure 4.6 Dip

Method 3: Press-ups. These are also a good indication of arm strength. *Note:* For women a modified version of the pull-ups and press-ups can be attempted. In both exercises shown some of the load on the arms can be reduced. Pull-up. Lower the bar so that the heels rest on the ground in the starting position.

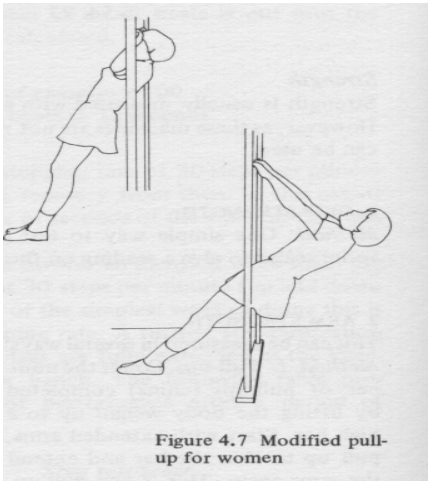


Figure 4.7 Modified pull-up for women

Press-up. Perform the press-up in a kneeling position. Make certain that the shoulders are directly above the hands and the chin touches the ground ahead of the hands when lowering the body. To equate players of different body weights the arm-strength index can be calculated. See Appendix I on page 120.

Figure 4.8 Modified press-up for women

Power
As stated in the previous chapter, power is more relevant to badminton than pure strength. Leg-power, in particular, is very important. This can be measured by recording the height a player can jump above his normal reach height. The test is the Sargent jump (see Figure 4.9).
Method: Face a wall and stretch both hands upwards against the wall. Mark the stretch height. Chalk the finger-tips of the dominant hand. Stand sideways to the wall and prepare to jump upwards. Jump and touch the wall to leave a chalk mark at the highest point. The dif-ference between the first mark and the chalk mark is measured. This is the jump height. A good indication of leg power is obtained if the result is related to the body weight.

Speed
The test is a short sprint.

Method: Record the time taken to run a straight 50 yards. A maximum of 50 yards is recommended particularly as the shorter distances are more applicable to badminton. The run is usually performed out of doors. If this is not possible the badminton hall can be used as an alternative. This may involve some turns and introduce the element of agility, so it is more suitable to run the length of the hall than the width.

Flexibility
A general indication of flexibility is to test spinal flexibility. There are several possible methods.

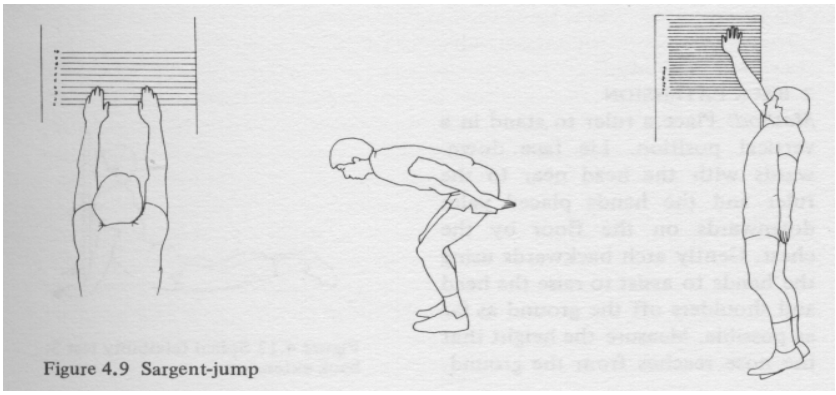


Figure 4.9 Sargent-jump

I STAND AND REACH TOES

Method: Take a chair and fix a ruler vertically at the front with the mid-point of the ruler at the level of the chair seat. Stand on the chair with the toes touching the front of the chair. Keep the legs straight and then gently bend down to reach the toes or beyond. The ruler will record the score of the reach beyond the toes (positive score) or above the toes (negative score).

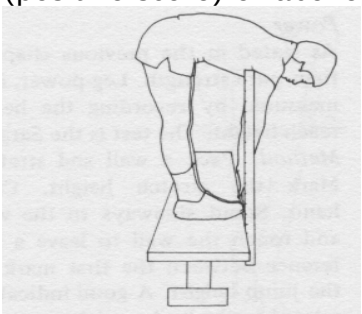


Figure 4.10 Spinal flexibility test1: stand and reach toes

2 SIT AND REACH

Method: Place a box on the floor with the mid-point of the ruler fixed horizontally at the edge of the box. Sit on the floor with the legs straight and feet resting against the box. Gently reach forwards to the toes and measure the reach score, i.e positive or negative.

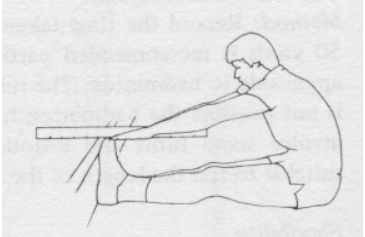


Figure 4.11 Spinal flexibility test 2: sit and reach

3 BACK EXTENSION

Method: Place a ruler to stand in a vertical position. Lie face downwards with the head near to the ruler and the hands placed palm downwards on the floor by the chest. Gently arch backwards using the hands to assist to raise the head and shoulders off the ground as far as possible. Measure the height that the nose reaches from the ground.

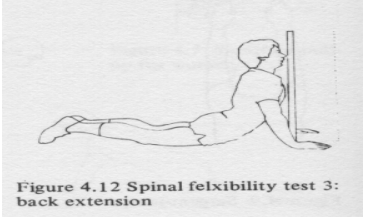


Figure 4.12 Spinal felxibility test 3: back extension

Correct body weight

An indication of body weight can be gained from the weight table (see page 30). Although this is some guide to fitness a more effective test is to examine the fat deposits on your body. Badminton is a non-contact sport and as such excess fat is quite unnecessary. There is too much fat if you can take hold of a handful of fat anywhere around the waistline. There is too much fat if you look in the mirror and cannot see good muscle defini-tion in the stomach and the legs.

There are more accurate ways of assessing body fat but they require special instruments such as skin-fold calipers. Occasionally inexpensive plastic skin-fold calipers are sold in association with slimming campaigns and these are a useful substitute.

5

The Physiological Basis of Training

All movement is dependent on muscular contraction. This involves two main factors. The first is the supply of energy required to enable the muscles to contract and this will involve an examination of the energy systems. The second is associated with the quality of muscular contraction which is considered to represent the strength of the muscle. Both factors must be considered to understand fully the physiological basis of training.

THE ENERGY SYSTEMS

The human being, whether active or at rest, is constantly converting energy from one form to another. During the game of badminton the most obvious use of energy is to maintain the muscle activity. The large muscular activity of running and jumping, the muscles involved in the finer movements of co-ordination and balance, and the muscles of the heart and respiration all require a constant supply. This energy comes largely from chemical energy stored originally in food or in the atmosphere but which is involved in a complex series of changes before being used in muscular activity. In performing these chemical processes the body can function with a high or low efficiency.

The purpose of training is to make the human body more efficient. This is achieved by improving the component parts of the energy system, rather like putting a more powerful engine in a motor-car. Alternatively, the component parts can be made to operate more efficiently, analagous to tuning the engine. All muscular activity is dependent upon one or more of the three basic energy systems. These are three methods of making energy available to the muscle cells so that they can contract and cause movement. They are:

1 the oxygen system

2 the ATP-PC system

3 the lactic acid system

Few coaches and players are aware of the importance of these energy systems to the game of badminton and even more importantly, how to train these energy systems to improve playing performance.

The three energy systems can be divided into those requiring oxygen *(aerobic)* and those not requiring oxygen *(anaerobic).* The one requiring oxygen is the first one to be considered and is called the oxygen system. The other systems, the ATP-PC and lactic acid systems are *anaerobic* and do not require oxygen.

The Oxygen System

This system, essential for badminton play, relies on the transport of adequate supplies of oxygen from the atmosphere to the working muscles. Oxygen is required at the working muscles as part of the reaction to provide energy. The lungs, the blood stream and the heart are all involved in this transfer and must be highly efficient to ensure that oxygen reaches the muscles with the minimum of delay. When the intensity of exercise is such that the supply of oxygen from the atmosphere is adequate for the demands of the working muscles, the oxygen system is used. Many activities of a long-term nature (endurance activities) operate predominant-ly with the oxygen system. This is most clearly seen in activities such as middle- and long-distance running. The training for these events is aimed to develop a highly efficient oxygen energy system. Such events are characterized by lengthy periods of exercise with some, but little, variation in intensity. This is called steady state work, the oxygen energy system being used almost exclusively in this work.

The ATP-PC and Lactic Acid Systems

In many activities, however, the form of the activity is incompatible with steady state work. This is typical of badminton where the intensity of play fluctuates. Parts of the game are spent standing still, parts in moving slowly (retrieving the shuttle) and much time in moving quickly. In such a game the oxygen energy system is not sufficient. Shortly after starting to move quickly, the aerobic method of supplying energy to the working muscles becomes totally inadequate. The muscles work so rapidly that the energy they require is simply not met by the transfer of oxygen from the atmosphere. In this situation, alternative, more rapid methods of providing energy have to be found. Fortunately, there is a limited store of energy available in the working muscles which can be released rapidly to supply this greater demand. As this supply is not dependent upon the availability of oxygen it is called the *anaerobic energy* system.

There are two components of the anaerobic energy system which make the energy available in different ways. The first one to be activated is the ATP-PC system (adenosine triphosphate and phosphocreatine) in which the

primary fuel is a chemical, phosphocreatine, stored in the muscle cells. The breakdown of this chemical makes the energy available very rapidly. Very short, intense activities which take only a few seconds will get their energy from this system. Thus, in badminton, an explosive movement such as a jump-lunge to kill a serve, which only takes a second, will be using the ATP-PC system.

The second anaerobic energy system activated is the lactic acid or LA system. It is called the lactic acid system because the chemical fuel, glycogen, stored in the muscle, is converted into energy with lactic acid forming as a waste product. Like the ATP-PC system, energy can be produced rapidly by this system. However, the muscle cells cannot tolerate a high quantity of this waste product, lactic acid, and the muscles cease to function effectively and become extremely painful - one of the causes of `cramp'. If an activity is of such high intensity that the anaerobic system is used exclusively, then the available energy will only last for about 40-50 seconds. This is probably why an event lasting in the region of 50 seconds which is run at full intensity, such as the 400-metre run, is so exhausting and painful. When the energy produced by anaerobic methods is used up it is necessary to reduce the intensity of the activity and to allow the oxygen energy system to operate. This explains why so many players, after a fast intensive rally, walk around, delay returning the shuttle and take a longer time to prepare for the next rally. They have used up the anaerobic energy supply for the moment and switched to the oxygen system until the anaerobic energy systems are `refuelled'.

The majority of sporting events, badminton included, do not rely exclusively on either the aerobic or anaerobic energy systems. But the requirements of the game demand that each system is used. For this reason any training must be designed to ensure that both systems are fully developed.

TThe development of these three energy systems is dependent on the period of time spent working at maximum effort. The ATP-PC system is best developed by working at the appropriate maximum effort for periods of 5-10 seconds. The lactic acid system is best developed by working at the appropriate maxmimum effort for periods of 40-60 seconds. The oxygen system is best developed by working at the appropriate maximum effort for periods in excess of 3 minutes.

As badminton is a game that requires a combination of the energy systems, and each player will start with strengths and weaknesses in each energy system, Chapter 7 on training the energy systems will show how to develop a training programme for all the energy systems. The diagram

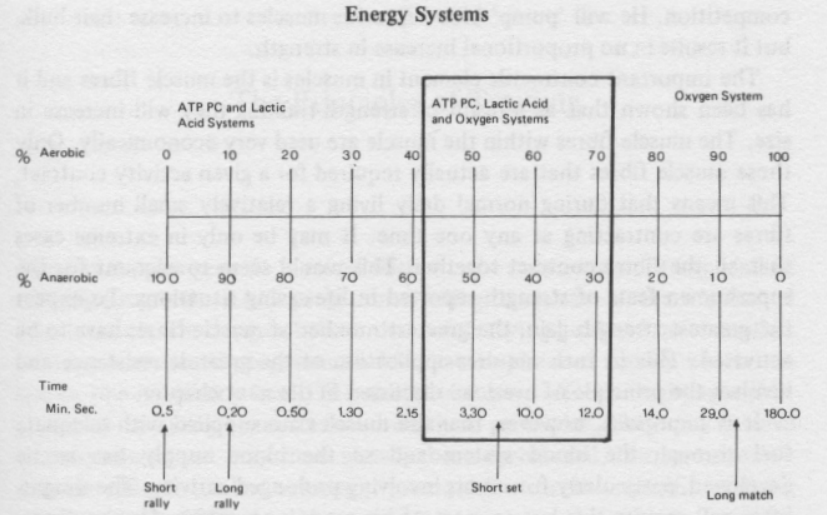


Figure 5.1 Use of the three energy systems of the body during badminton play

(Figure 5.1) examines the three energy systems and shows how they would all be involved in the game of badminton. The figure shows the approximate percentage of aerobic and anaerobic energy sources for given times working at maximum effort.

From the limited information available on badminton it is possible to infer which energy systems are required in the game. It has been shown in Chapter I that the game is made up of rallies which involves short bursts of intense activity. These would involve the ATP-PC system predominantly. Other rallies which last as long as 20 seconds involve, if played at maximum intensity, about 90 per cent of the anaerobic system which consists of the ATP-PC and lactic acid systems. A game may last only 8 minutes and will make demands on all three systems, whereas a match could last anything up to an hour and therefore requires a well-developed oxygen system.

STRENGTH

Strength is very closely related to the effective cross-sectional area of the muscles involved in the particular activity. The word `effective' is impor-tant because the cross-sectional area of a muscle could include tissues such as blood which are not contributing to the development of strength. A classic example of this is the preparation of the body-builder prior to

competition. He will `pump' blood into his muscles to increase their bulk, but it results in no proportional increase in strength.

The important contractile element in muscles is the muscle fibres and it has been shown that as a result of strength-training they will increase in size. The muscle fibres within the muscle are used very economically. Only those muscle fibres that are actually required for a given activity contract. This means that during normal daily living a relatively small number of fibres are contracting at any one time. It may be only in extreme cases that all the fibres contract together. This would seem to account for the superhuman feats of strength reported in life-saving situations. To expect the greatest strength gain, the greatest number of muscle fibres have to be activated. This in turn requires application of the greatest resistance and involves the principle of overload discussed in the next chapter.

It is important, however, that the muscles are supplied with adequate fuel through the blood system and so the blood supply has to be developed, particularly for events involving prolonged activity. The weight-lifter will require this less as most of his work is anaerobic. He can, there-fore, afford to develop large muscle fibres with less regard to the blood supply. A middle-distance runner will have far less bulk, but a highly efficient circulation to the working muscles. For badminton a compromise position is required. The player needs muscle strength so that he can exert the power required for an upward jump or an overhead smash but he must also be capable of sustaining muscular activity over a long period of time.

6

The Principles of Training

These principles provide a sound basis for the construction of any kind of training programme. Any programme failing to operate on them is limited in value. It is one thing to believe that one is trying hard and quite another to have a sustained programme which can be checked and by which one knows one is training hard. The ability to sustain effective training will be greater if the programme is based on these principles. They may involve common-sense and may have already been mentioned, but, even so, we consider them to be necessary prerequisites to the specific training suggested in Part Three.

The principle of generality

Training for most sports requires a good level of cardiovascular and respiratory efficiency. This means that the heart, lungs and bloodstream have to work well. The reason for this is that much of the fuel required by the working muscles comes from the bloodstream and if this is not operat-ing smoothly then the whole system will not be sufficiently adaptable to allow further improvement. This system sets the limit for further training and thus needs to be developed as soon and as completely as possible.

The principle of specificity

Many players who consider themselves fit for badminton might be surprised when they go swimming on holiday and find themselves out of breath after a short swim. This example serves to illustrate that training for one sport does not necessarily mean fitness for another as any training is sport-specific. The implication for badminton is that the player and coach must analyse the demands of the sport and train accordingly. The sort of work appropriate for on-court training is explained in detail in Chapter 9.

The principle of individual specificity

The concern here is with the fact that each player is an individual in terms of his playing style and his initial level of fitness. Consequently different individuals will adopt different training programmes to cater for their different needs.

Some players rely on a power game and adopt a dynamic attacking style of play. Others are content to keep the rally going and play a patient sort of game to try to tire the opponent or outmanoeuvre him. Different training methods can be used to strengthen a specific style of play or to develop others and so extend the technical/tactical repertoire of the player.

An example of this was seen in the 1977 World Championships in Sweden when Ray Stevens (England) played Fleming Delfs (Denmark). Stevens had practised a certain move continually under pressure in train-ing. This involved a lunge jump in the forecourt to hit a backhand winner from the net. Analysis of Delfs' play had shown that after his smash to the backhand he came into the forecourt for the block return and played a forehand spinner to the net. The training paid dividends and Stevens was able to use his skill effectively to hit backhand winners in that situation. Although this was a tactical ploy, it could not have been achieved if Stevens had not developed the fitness to play a controlled return to the smash and the ability to move consistently forward and explode into the net.

The level of fitness aimed at is another aspect of individual specificity and is an important feature of this book. The work demands of an inflexible training programme may be just right for some and too easy for others. This is why the activities suggested later can be adapted to the fitness levels of each player.

The principle of overload

There is no magic pill to make training easy. Training of necessity has to be demanding before it will be of any benefit. In general, training for badminton by playing badminton may maintain a given level of fitness but will not improve it. This is because the body is not being sufficiently over-loaded. Thus we have to push the body to levels of work intensity which are greater than in the actual game situation.

There are some useful methods of overloading the body in playing conditions. These involve conditioning the game in some way or playing `two versus one' games. They will be discussed in Chapter 9. If badminton is played at a leisurely, recreational level with no great work demand, then the extent of the overload need not be very great to increase fitness. However, those players who take their game seriously need to engage in training activities which regularly overload the system at a higher level. This will produce a much more marked training effect.

The principle of adaptation

One of the unique characteristics of the human body compared with any machine is its ability to adapt to work in a manner which improves its performance. Machines, often through misuse or ageing, adapt to decrease performance. Work, particularly of an overload nature, forces adaptation to increase performance. All good training is designed to cause this adaptation. Consequently, the intensity and duration of any training programme must be such that performance is regularly adjusted in an upward direction. The result is that the body should be able to tolerate a further increase in work load and a further adaptation should occur.

It must be remembered that no two individuals will adapt at the same rate. They have different physical and physiological constitutions and thus tolerate training in different ways. This is another reason why it is necessary to design programmes specifically for the individual. Adaptation also varies according to the initial level of fitness. A very unfit person will adapt rapidly and achieve quick changes in performance. As he gets progressively fitter he must recognize that the adaptation process will be slower. Knowledge of this fact can be a source of encouragement for an athlete in the early stages of training and should help to prevent dis-appointment later when he does not improve at the same rate.

The principle of progression

Many players start their training from a low level of fitness and may be over-enthusiastic in the early stages. This over-enthusiasm usually leads to an excess of training and results in the painful feelings associated with fatigue which makes them reluctant to continue training. In addition intense work too soon contravenes the principle of generality and can cause injuries. To avoid harmful effects any athlete is advised to build up the level of work intensity over a period of time. It is not possible to be specific about the length of time it takes to progress to new fitness levels. However, it is far better to progress through increasing levels of fitness over several weeks or months than to make an error of judgement and find that it is not possible to tolerate the work intensity.

The fitness levels that can be achieved by progressive training can be quite remarkable. The earlier that one starts to train for a given competition or tournament the more time will be available to progress to the required standard.

The principle of reversibility

This is, in essence, the opposite to adaptation. It is a reminder that not only can

improvement in fitness not be maintained if training stops but that the athlete will drop below his current level of fitness. The player who has had a leg immobilized in a plaster cast after a knee operation will have experienced the extent of muscle wastage that can occur in such a short time. This example, though a dramatic illustration, emphasizes that rever-sibility will occur during any period when training is prevented.

For these reasons it is important to maintain some degree of training even though injury may prevent full activity. An injury to the lower leg, for example, should not prevent training of the upper body. A number of specific exercises helped by some imagination and inventiveness should make it possible to continue to train for endurance fitness despite such injury.

Reversibility is most likely to occur when the main season is over. This is the time when participation in other forms of recreational activity is a sound investment to safeguard against loss of fitness.

The principle of measurement

Measurement is necessary to check progress and so make possible an accurate evaluation of the training programme. On the basis of the evalua-tion the programme can be modified as required. Charting progress can be an interesting feature of the training and is of much value in that evidence of improvement can provide the motivation necessary to enable the athlete to persist and work harder in training. This principle and approp-riate methods of measurement were explained in greater detail in Chapter 4.

The principle of competition

Badminton is a competitive game and consequently the performance of the athlete is ultimately assessed within a competitive situation. Competi-tion is a factor which motivates the athlete to improve his performance. It is important to maintain the emphasis on competition in all areas of the athlete's work if he is to be motivated to extend the limits of his perfor-mance. The athlete who has developed his ability to extend and maintain a high level of performance in his training should continue to remain highly competitive at all times in match play. For these reasons the competitive element should be brought into the training programme. In training the athlete can compete against: the clock, a personal target, resistance, another player.

The principle of variety

Much training lacks excitement and is often tedious. One way to prevent this is to vary the approach, the activity, the intensity and the duration of the training programme. This is why a variety of activities have been included in Part Three even for those training aspects which are quite specific in nature. A training programme which is interesting and attractive is more conducive to hard work and thus more likely to achieve good results.

SUMMARY

At this stage a brief summary of the theory should make it easier to follow and make use of the remainder of the book. In Part One we explained that the evaluation of the work demands of the game were determined by the nature of the game, i.e. the type of activity revealed in playing the game. Once we knew the sort of work performed by the player it would become possible to examine the effects on the body and thus train the body to work with greater efficiency. Various methods of evaluating the work demands of the game were used and on the basis of the findings the requirements of the players were considered. The simple conclusion was that the player must be fit for the work.
Consequently, in Part Two our enquiry looked at the nature of fitness and gave an explanation of the components involved. As fitness is improved by training then eventually a specific training programme would have to be planned. The success of any programme is measured by the results it achieves and in this case the training should result in a fitter player. As improvement can only be assessed from some starting point it follows that some method of measuring fitness prior to training is necessary. Chapter 4 suggested some methods of testing and measuring the fitness components.

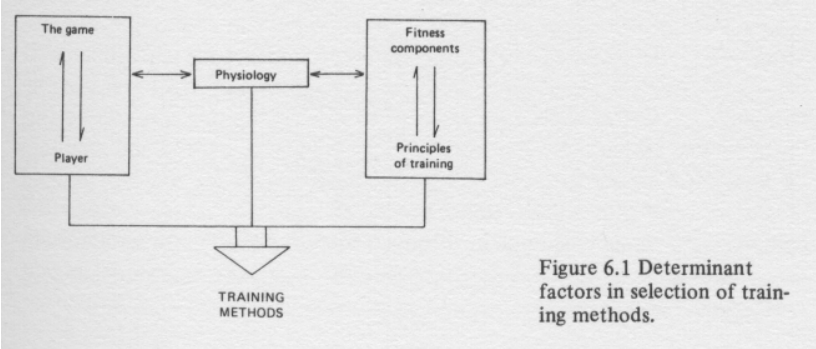


Figure 6.1 Determinant factors in selection of training methods.

The necessity of a fitness training programme led to the examination of training theory for, though it is important to know what to train, it is even more important to know how to train the body. The study focused on the physiological basis of training with a detailed discussion of how the body functions when undergoing work of varying intensity. On the basis of this knowledge it became possible to formulate a number of principles of training which underpin the construction of any training programme. Figure 6.1 illustrates these relationships.

PART THREE

Getting Fit

This section is concerned with the practical application of the theory discussed in the previous chapters. It considers the training of the energy systems and improving the fitness components in work both on and off the court. All the work selected will be relevant to the game of badminton. The different training methods are designed to develop specific aspects of fitness though it is inevitable that, at times, there may be a slight overlap. For example, work on the anaerobic system may also improve the player's power or agility and vice versa. This is quite acceptable as long as the coach or player is clear about the purpose of the exercise.

7

Training the Energy Systems

Although the evidence is limited, it does appear from Chapter 1 that a large proportion of the game of badminton will be played at an intensity which requires energy from non-oxygen (anaerobic) sources. The length of the total game indicated that the activity is of an endurance nature and must therefore be using aerobic sources as well. It is also known that the development of intense rallies of a highly demanding nature can only be based upon a sound cardiovascular and respiratory endurance fitness. An efficient heart, lungs and circulatory system is a prerequisite for any form of training. To train the energy systems several main factors are involved. The application of these factors takes the form of an interval-training programme. They are:

1 *The work load* which is the total amount of work to be completed in a session. This is divided into a number of work intervals known as *sets.* Each set consists of a fixed number of consecutive *repetitions.*
2 *The work interval is* the time allowed to complete each set.
3 *The rest interval is* the period of time allowed between bouts of work.
4 *The work/rest ratio is* the relationship between the work interval and the rest interval.
5 *The activity* undertaken during the rest interval.

The interrelation of these factors is of the utmost importance if the player is to obtain the maximum training effect. The charts overleaf show clearly the balance between these factors. A careful study of the charts will make it pos-sible to devise work appropriate to the training of a particular energy system. Thus if a player wanted to develop speed and power for game situations which only involved a few seconds of very intense work, he would require to train the ATP-PC energy system. A training time is selected (say *15* seconds) and a training activity chosen which will allow him to work maximally for *15* seconds. The simplest of these would be a sprint or shuttle-running. However a more badminton-related activity would be shadow badminton or playing to continuous high-pressure feeding from another player. From the table it can be seen that the player has to do 9 repetitions of the

Interval-Training Chart Based on Training Time*

Major energy system	*Training time (in mins/secs)*	*Repetitions per set*	*Sets per workout*	*Work/rest ratio*	*Rest interval activity*
ATP-PC	0.10	10	5	1 : 3	light
	0.15	9	5	1 : 3	light
	0.20	10	4	1 : 3	light
	0.25	8	4	1 : 3	light
ATP-PC	0.30	5	5	1 : 3	mild
and	0.40–0.50	5	4	1 : 3	mild
lactic acid	1.00–1.10	5	3	1 : 3	mild
	1.20	5	2	1 : 2	mild
Lactic acid	1.30–2.00	4	2	1 : 2	mild
and	2.10–2.40	6	1	1 : 2	mild
oxygen	2.50–3.00	4	1	1 : 1	light
Oxygen	3.00–4.00	4	1	1 : 1	light
	4.00–5.00	3	1	1 : ½	light

Interval-Training Chart based on Training Distance*

Major energy system	*Training distance in metres*	*Repetitions per set*	*Sets per workout*	*Work/rest ratio*	*Rest interval activity*
ATP-PC	50	10	5	1 : 3	light
	100	8	3	1 : 3	light
ATP-PC					
and	200	4	4	1 : 3	light to mild
lactic acid	400	4	2	1 : 2	light to mild
Lactic acid	600	5	1	1 : 2	mild
and oxygen	800	2	2	1 : 1	light
Oxygen	1000	3	1	1 : ½	light
	1500	3	1	1 : ½	light

*Modified from D.K. Mathews and E.L. Fox, *The Physiological Basis of PE and Athletics*, W.B. Saunders Company (Philadelphia, 1976). Light work involves walking and gentle flexibility exercises. Mild work involves jogging and flexibility exercises.

15-second activity to make up one set, with walking or flexibility as the activity during the rest interval. (The rest-interval activity is important for it aids recovery.) Between each repetition the rest interval must be three times the work interval. In this case the player rests for 45 seconds before starting

the next repetition. After a complete set of 9 repetitions he can then have a more thorough warm down or change of activity before starting the next set of 9 repetitions. He will complete 5 sets as a workout to train this energy system. Some players may be able to use a running track or a pitch marked out for running and if so the follow-ing table gives similar information for training the different energy systems but based on running distance as opposed to time.

Thus a player who considers himself to have a reasonable cardiovascular and respiratory level and is starting to switch fairly early in the season to a more intense quality game may wish to continue to train his oxygen system and start to develop his lactic acid system. He could select an 800-metre run as his training distance. He would run at maximum effort, timing his run, so that he had the same relief interval as the running time. He would repeat this twice to complete the set and one further set would follow to complete the workout.

Many sportsmen doing this type of training find difficulty in knowing what is meant by maximum effort. It would not be uncommon for a player to run the 800-metre interval by going so fast to start with that the second part of the interval was by necessity no more than jogging. The effect of this would be to train a different energy system because although it might appear that he is running 800 metres it may in effect have been a 200-metre sprint followed by a 600-metre recovery jog.

The following table may help in determining the work rate.

Interval-Training Chart based on Work Rate*

Training distance in metres	*Work interval*
50	1½ seconds *slower* than the best time recorded from a moving start
100	3 seconds *slower* than the best time recorded from a moving start
200	5 seconds *slower* than the best time recorded from a moving start
400	1–4 seconds *faster* than average 400-metre run in the best recorded time over 1600 metres
600–1500	3–4 seconds *slower* than the average 400-metre time in the recorded time over a mile run

A player who is using 100 metres as his training distance will measure his best time with a moving start for 100 metres. He then adds 3 seconds to that time and uses that as his training time to complete the 100 metres for every repetition. A player who is using 400 metres as his training distance will record his best time for four laps (1600 metres). This is divided by 4 to give his average time and between 1-4 seconds (principle of progression) *subtracted* from the average time to produce his training time for 400 metres.

Another method of determining the work rate is to base it upon heart rate. Heart rate can be measured as suggested in Chapter 1 (page 20) by counting the number of beats at the carotid pulse for 6 seconds and multiplying by 10. The following table is a guide to the heart rate which should be maintained during the work period.

Although these figures are `rule of thumb' and partially contravene the principle of individual specificity, they may help as a guide to the intensity of work required to train the different energy systems. If a player finds he is not maintaining the required heart rate then he must either work harder or accept that he may be training a different energy system.

Interval-Training: Heart Rate

System	*Heart Rate*		
	Unfit	Moderately fit	Fit
Oxygen system	150 minus age	170 minus age	190 minus age
Lactic acid system	170 minus minus age	190 minus age minus age	200 minus minus age
ATP-PC system	160	170	180+
Resting rate* between work intervals	120	130	140

*Allow the heart rate to return to the recommended resting rate before beginning the next interval of training

8

Off court Training

There are a variety of different routines that can be used to develop fitness by off-court training methods. A number of these are listed below. The correct use of these routines is determined by reference to the different interval-training charts. The coach or player is advised to check with the training chart if there are any doubts about the work interval or the work load to be completed in a routine.

AEROBIC TRAINING

This will be of a steady state nature but must be of sufficient intensity to force adaptation. A popular activity such as jogging may be acceptable for middle-aged men who wish to maintain a minimum level of fitness and prevent the build-up of fatty deposits in the coronary arteries. However, it acts only as an overload for such sedentary activities as sitting, standing and walking. As these activities are not a feature of the game of badminton this will illustrate the limited value of jogging for serious badminton train-ing. It is quite acceptable to jog as a warm-up activity or when the levels of fitness are known to be extremely low, but for the player in reasonable physical condition, who is injury free and playing regularly, jogging should not be his only form of aerobic training. The emphasis should be on quality running when the player maintains a heart rate appropriate to his level of fitness (see the chart opposite) and this could take the form of the following routines:

1 Time run over a set distance of 2, 3 or 4 miles
2 Distance run over a set time, say 6, 12 or 16 minutes
3 Quality runs of 3-4 minutes with a 3-4 minute rest between each one (total of 4 runs per workout)
4 Quality runs of 4-5 minutes with a 2-3 minute rest between each one (total of 3 runs per workout)

Method: Make a record of the time or distance and try to improve it on each occasion. Running on a track makes the measurement of distances easier but is less interesting than in less formal surroundings. Road-running is often convenient

because the run can start from home, but some people suffer from muscle soreness as a result of running on hard surfaces. This often means that they are running `heavily' and should concentrate on relaxation and running `lightly' to relieve the condition. The ideal surface is dry grass particularly as undulating conditions can make the run more interesting.

ANAEROBIC TRAINING

The following routines are ideal for individuals or groups:

Shuttle-running
Each team has four members. Each player runs the length of the badmin-ton court and back twice over (or about 15 seconds). One player runs while three rest to obtain the correct work/rest ratio.

Chain-running
Run in small groups on a flat open space one behind the other about 3 yards apart. When the whistle is blown try to overtake the player in front and return to jogging on the next whistle (after 5, 10, 15, or 20 seconds).

Square-running
Mark a square with the sides about 30-40 yards in length. The player begins at point A and sprints to B and then jogs for at least three times the time it took him to sprint from A to B, i.e. 7 seconds' sprint and 21 seconds' jogging. He then sprints again and repeats the routine. Build up the length of the sprint each time to cover two and three and eventually four sides of the square with an equivalent rest interval of three times the sprinting time on each occasion. A simple way to avoid the timing problem is to sprint one side and jog two sides; sprint two sides and jog four sides; sprint three sides and jog six sides; sprint four sides and jog eight sides.

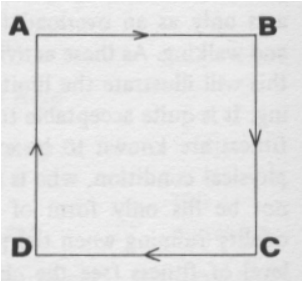


Figure 8.1 Square running

Paarlauf
This is Norwegian for pair-running and involves two players running as a pair with one running while the other is recovering. Normally an athletics track is used but any flat surface can be adapted for this activity. Player A, carrying a baton, sprints around the track and hands the baton to B, who then sprints around the track. Meanwhile player A jogs back to his starting position ready to retake the baton when B arrives. B hands over the baton and jogs back to his starting position while A sprints round. This routine only gives a work/rest ratio of 1:1 and therefore could not be maintained at a high intensity for long. However, it can become very competitive with many pairs racing each other.

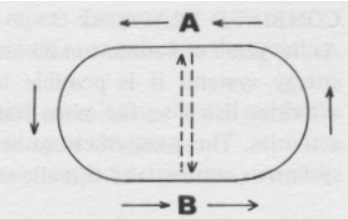


Figure 8.2 Paarlauf (pair-running)

Sprint relay
The players spread out equidistant around a circular course with two players at the starting base. Ideally four players are neces-sary to maintain the 1:3 work/ rest ratio. Player A sprints to B, B to C, C to D, D to player A's new position and so on.

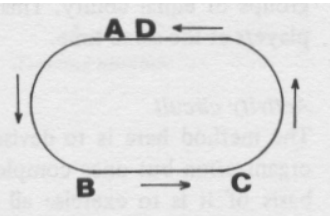


Figure 8.3 Sprint relay

Timed sprint
The players sprint as far as possible in a set time of 4, 5, 6, 7, or 8 seconds. On the signal at the end of the sprint each player places a shuttlecock down to mark the distance he has reached. He jogs back to the start and repeats the sprint. Each player aims to improve his distance in each run. This routine also shows performance drop-off.

COMBINED TRAINING

As the game of badminton involves a combination of aerobic and anaerobic energy systems it is possible to train the systems separately as in the activities listed so far or to train them both together as in the following activities. These activities can be adjusted to place greater emphasis on one system or another and this allows greater variety of presentation.

Fartlek

This word means speed play and involves a long run in which sprints, fast walks, medium pace and three quarter-pace running are interchanged with one another at will. This has the advantage of making the run more inter-esting by running on varied surface conditions and adjusting the speed appropriately. Set objectives during the run are established, such as a short piece of timed running between two clear landmarks, and the player tries to beat his time on each occasion.

Running circuit

A suitable training area is divided into legs of different lengths but in the region of 400-800 metres. The ideal work:rest ratio is 1:2 for training both energy systems and, therefore, the training area must be organized so that the recovery jog between one station and the next takes about twice the length of the run. It is possible using a large area such as park-land or waste ground to organize the stages so that groups of players race to another group and rest while they run their stage. Run players in groups of equal ability. This activity can accommodate large numbers of players at the same time.

Activity circuit

The method here is to devise a form of circuit-training. It requires some organization but once completed presents a very challenging activity. The basis of it is to exercise all parts of the body by overloading different muscle groups in turn. Many forms of activity can be incorporated into the circuit. The activities shown here require a minimal amount of apparatus. The principle of individual specificity is adopted in setting the number of times each activity is performed. Two players working together set the level by one working and the other acting as scorer.

I Player A begins the first activity and performs as many repetitions as possible within 30 seconds. The score is noted and player B does the same.

2 They move on to the next activity and repeat the process.
3 The score for each activity is halved and this is entered as the training number on the record card.
4 The player carries his record card around completing the circuit three times at the training rate. He does this without stopping.
5 The player times his circuit and tries to improve his time on each occasion.
6 The maximum score for each activity has to be re-assessed periodically and halved to obtain the training number for the circuit of three laps.

Suitable activities might include:
1 Step-ups (legs)
2 Sit-ups (stomach)
3 Press-ups (arms)
4 Back-lifts (back)
5 Sprints (back and forward across the court) (legs)
6 Leg-raise (stomach)
7 Star jumps (legs)
8 Squat-thrust (arms and legs)

Note that particular muscle groups are not worked one after the other. This allows a recovery period before they are worked again. A suitable record card is shown below.

Activity-Circuit Record Card

Name

Activity	*Maximum in 30 secs*	*Training number*
Step-ups		
Sit-ups		
Press-ups		
Sprints		
Leg-raise		
Back-lifts		
Star-jumps		
Squat-thrusts		

Date	Time	
Date	Time	Improvement
Date	Time	Improvement
Date	Time	Improvement
Date	Time	Improvement
Date	Time	Improvement

This card will be suitable for six training sessions after which time the maximum number for each activity would be re-established. The training schedule would be revised.

Advanced activity-circuit

This is identical in principle to the third routine but adds some activities which can be performed in a well-equipped gymnasium. Add the following activities:

1 Dips (arms)
2 Inclined sit-ups (stomach)
3 Bench jumps (legs)
4 Chins (arms)
5 Hanging leg-raise (stomach)
6 Skipping (legs)

Obstacle circuit

The apparatus is arranged so that the player is presented with a continuous series of obstacles as he moves around the circuit without stopping. The circuit requires a fairly well-equipped gymnasium, but does have the advantage that by controlling the work and rest ratios, the correct energy system can be trained.

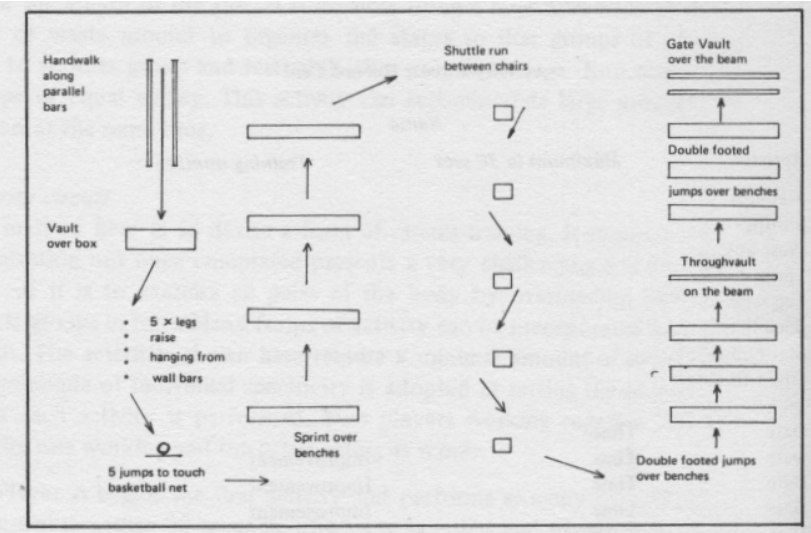


Figure 8.4 A typical obstacle circuit

The players aim is to increase the distance he travels around the circuit in the training time set for each work interval.

Mainly anaerobic:

10 seconds' work, 30 seconds' rest

15 seconds' work, 45 seconds' rest

20 seconds' work, 60 seconds' rest

Combined:

1 minute 20 seconds' work,

2 minutes 40 seconds' rest

2 minutes' work, 4 minutes' rest

Mainly aerobic:

3 minutes' work, 3 minutes' rest

4 minutes' work, 2 minutes' rest

A typical obstacle circuit is shown in Figure 8.4.

9

On-court Training

If training on court is to be effective it must be closely related to the type of work that occurs in the game. Fortunately, the very nature of the game makes it possible to design realistic training routines. The rectangular shape of the court makes it possible to identify and isolate the work patterns of the player. This is particularly so in singles play for here, as the player must cover his complete court, clearly defined movement patterns emerge. A very basic pattern would be as follows: the player begins in the midcourt, travels to the rear-court or forecourt to play a stroke and returns to the midcourt. In the game many variations of this pattern flow into one another to make up the game, though the type of pattern depends on the situation and the tactics employed. Each pattern involves movement between the rearcourt, midcourt and forecourt as the player travels round his court to perform his strokes.

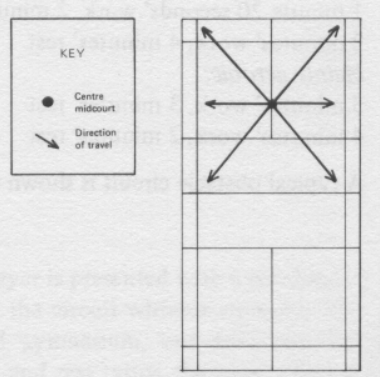


Figure 9.1 Court patterns

In each movement pattern the player travels at varying speeds, makes abrupt halts and rapid changes of direction and performs a number of different strokes. This work requires a highly developed energy system in addition to strength and power, agility, flexibility, endurance and speed.

Consequently, much of the training on the court will involve the repetition of those movement patterns which actually occur in the game. In the context of training the movement pattern is known as the training sequence. In any training sequence a certain degree of skill is required. Inevitably there will be a close connection between fitness training and skills practice for each complements the other in the successful performance of a move-ment pattern. Indeed, this is the added advantage of training fitness on the court, for not only is it very realistic but it does also develop the repertoire of skills and tactical moves. The disadvantage, if any, is that it is possible to forget the point of the exercise. It should not be forgotten that the purpose of this book is to help to develop fitness. The development of skill, though a welcome addition, is incidental to the main aim, fitness. The close relationship of skill and fitness sometimes makes it difficult to plan a fitness routine. When an exercise is constructed to develop a certain aspect of fitness it is assumed that the player's technique is proficient and will enable him to perform the training exercise according to the principles of training. Should his technique be inadequate, the exercise will soon break down and lose its value. There are then several options available. One can either devise a new training exercise which requires less skill, or return to the practice court and improve the tech-nique, or perform the sequence and only mime the stroke (shadow badminton).

It is not easy to select appropriate patterns, for what counts as approp-riate is dependent on the careful evaluation of a player's fitness require-ments and that involves a thorough knowledge both of the game and of how a player performs within the game. That, fortunately, is a problem that lies within the province of the coach and player, for it is a matter of individual specificity. Although we will offer some advice in Part Four, on how to plan a programme for an individual player, our immediate concern is to devise appropriate training routines.

TRAINING SEQUENCES

The correct use of a sequence is important if the player is to gain the maximum training effect. The following section will show you how to devise and use a training sequence.

Selecting a sequence

A training sequence may involve one or several patterns of movement, examples of which are shown overleaf.

The sequence can be performed with or without a shuttle. When performed without a shuttle the player works alone and the training takes the form of shadow badmin-ton. When performed with a shuttle (see Figure 9.5) a feeder (F) will be required to hit the shuttle to the appropriate parts of the court. In some training sequences there will also be a counter (C).

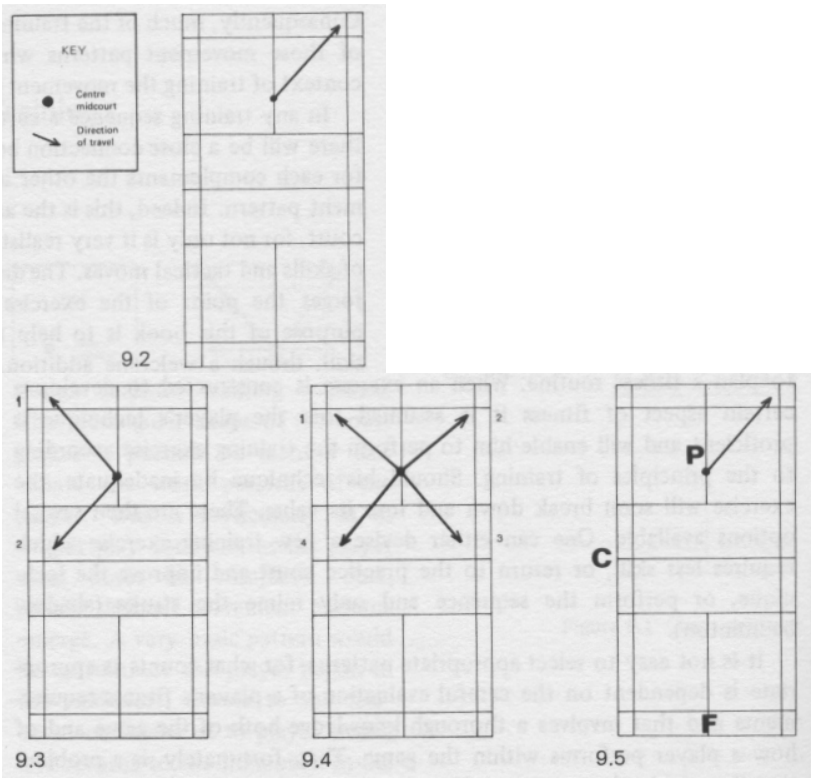


Figure 9.2 Single training sequence. From centre midcourt to backhand rearcourt and return to centre midcourt

Figure 9.3 Combined training sequence. From centre midcourt to forehand rear-court and return to centre midcourt to travel to forehand forecourt and return to centre midcourt

Figure 9.4 Multiple training sequence

Figure 9.5 Training sequence using a shuttle. P = player, F = feeder, C = counter

Performing the sequence

In all the sequences the player doing the work will be known as P. The feeder must concentrate on good control and accurate placing of the shuttlecock. He has a responsible task for he controls the work rate in the sequence.

He can slow the rate down by hitting the shuttle on a high trajectory or speed it up by increasing the pace of the shuttle or hitting it on a low trajectory. Feeding can either take the form of continuous rallying as in some steady state work or else the feeder hits or throws single shuttles to selected parts of the court. The task of the counter is to keep the score of repetitions and to ensure that the sequence is correctly performed with regard to the work rate and the accuracy and control of the feeder.

The work load

Each training sequence will involve a number of set repetitions. This is the work load: the quantity of work the player sets out to perform. A player sets out to perform 10 repetitions of a sequence. As he becomes fitter he may increase his work load to 20 repetitions. The work load is determined by what is relevant to the training programme. It is indicated on the train-ing sequence as follows:

Sequence	Repetitions
	10
	5

The work rate

The work rate is the time allowed to perform a particular work load. The rate at which a player works is determined by the energy system he intends to develop. Work at a high rate of intensity will develop the anaerobic energy system whereas work at a slower rate (steady state work) will develop the oxygen system. An evaluation of the player's fitness level and the application of the principle of overload will determine the most suitable work rate for the player.

TRAINING SEQUENCE DESIGN

This is a difficult problem and requires careful thought and planning. It may also require some experimentation before a good training sequence is worked out. There are several stages in the process.

Select the training sequences

These involve the movement patterns and strokes to be used. Decide these after a careful consideration of the player's requirements, i.e. the work necessary to develop the energy system or fitness components.

Decide on the method of working

Is to work alone or with a feeder?

The feeder

Will the feeder play a continuous rally or will he hit individual shuttles and/or feed by hand? Where will the feeder be positioned? Remember the sequence must be realistic. How will the feeder hit or throw the shuttles? The trajectory must be appropriate for the work rate and realistic for the training.

The work load and the work rate

How many repetitions will be performed in each set? How much time will the player work for and at what intensity? How much time will be allowed between repetitions? The interrelation between work load, work rate and rest interval is of great importance if the maximum training effect is to be obtained. For the answers to these questions check with the appropriate Interval-Training Chart in Chapter 7.

TRAINING THE OXYGEN SYSTEM

There is some difficulty in devising on-court training routines for the oxygen system. A study of an interval-training chart will show that steady state work must be maintained for a period in excess of three minutes to develop the oxygen system. The problem arises that, owing to the nature of the game, work which may involve the oxygen system for the highly skilled fit player will most probably utilize the anaerobic system for the less skilled and less fit player. Thus the majority of players will be unable to sustain three minutes of continuous rallying routines on the court.

This problem was clearly illustrated when two international players performed routines designed to train the oxygen system. One completed three repetitions of 10 minutes each without fatigue while the other was unable to complete three repetitions of 3 minutes' duration at the same work rate. For the latter player the work overloaded his system to the extent that he had to use the anaerobic system which could only operate for a limited period of time.

Though this problem exists it does not rule out on-court training for the oxygen system. It simply indicates that perhaps more beneficial routines could be performed in off-court training in the early stages. The problem is raised simply to re-emphasize the need for much thought and care in the design of a training sequence.

The capacity to complete the minimum period of three minutes as steady state

work is dependent on a reasonable level of skill and fitness, so the routines will take the following form. There will be work with a feeder (continuous rallying) and work without a feeder (shadow badminton). Each player or coach must assess the value of the form selected in relation to the player's needs.

I SHADOW BADMINTON

Method: The player selects a training routine of 4 repetitions of 3 minutes with a 1:1 work/rest ratio (see the interval-training chart on page 56). He starts to perform numerous movement patterns, miming strokes, etc., at a work rate which will enable him to complete 3 minutes.

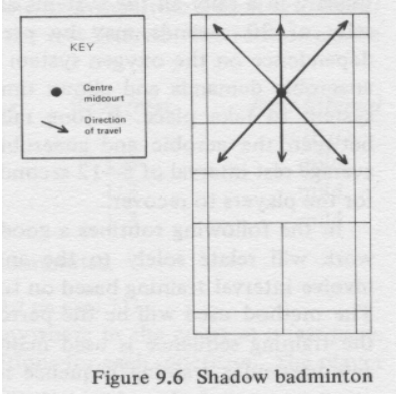


Figure 9.6 Shadow badminton

2 CONTINUOUS RALLYING

Method: The player selects a train-ing routine of 4 repetitions of 3 minutes with a 1:1 work/rest ratio. The feeder hits drops and clears to the corners and the centre of the court. The player returns all shots to the feeder who can alter his position during the rally to the sides or the centre of the rearcourt or the forecourt. Advanced players can include smashing during the rally. The feeder should keep about six shuttles close at hand to continue feeding should the rally break down. Should this happen the player must keep moving at the same rate until the feeder hits another shuttle into play.

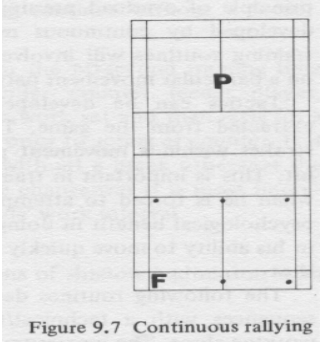


Figure 9.7 Continuous rallying

3 COMBINATION TRAINING

Method: The player alternates between one repetition of shadow badmin-ton and one repetition of continuous rallying until the required number of repetitions in the set have been completed.

TRAINING THE ANAEROBIC ENERGY SYSTEM

This is the most important form of on-court training. It is very rarely that a rally extends to 60 seconds in the modern game. In singles 90 per cent of all rallies last from 2 to 12 seconds. Therefore, a rally played at maximum speed would involve mainly the lactic acid and ATP-PC systems. Usually in a rally all the systems are operating and so, even though a long rally of 30 seconds may be predominantly anaerobic, there is some dependence on the oxygen system which provides a recovery period from anaerobic demands and allows time for some refuelling of the anaerobic system to take place. If long rallies did not involve some interchange between the aerobic and anaerobic systems, it is doubtful whether the average rest interval of 5-12 seconds between each rally would be sufficient for the players to recover.

In the following routines a good oxygen system is presupposed and the work will relate solely to the anaerobic energy systems. The routines involve interval training based on training times (see the chart on page 56). The method used will be the performance of training sequences. Though the training sequence is used mainly to develop fitness, the selection of any particular training sequence is determined by the technical/ tactical requirements of the player. It is important to re-emphasize that the ability to perform some training sequences and work according to the principle of overload presupposes an appropriate level of skill. As skill is developed by continuous repetition of the same stroke, some of the training routines will involve continuous rallying of one or two strokes on a particular movement pattern.

Tactics can be developed by the repetition of specific situations extracted from the game. Tactical situations may involve a number of strokes within a movement pattern and usually conclude with a winning hit. This is important in training for the player can experience situations when he is forced to attempt to hit a winner under pressure. There is a psychological benefit in doing this for the player develops the confidence in his ability to move quickly and seize the opportunity to make a winning shot.

The following routines develop fitness by performing specific training sequences with a technical/tactical emphasis either using a feeder or working alone. The maximum time selected for work is 60 seconds and the shortest time is 10 seconds. Variations on these routines, either of training sequences or interval times can be devised by the player or coach. We hope that the reader will construct training routines for his needs in accordance with the principle of individual specificity.

THE LACTIC ACID SYSTEM
Examine the chart on page 56 showing interval-training based on training times.

First routine

Training time of 60 seconds. Three sets of 5 repetitions each set. Work/ rest ratio of 1:3 and mild exercise in the rest interval. The routine can be written as below.

Set	*Training time*	*Repetitions*	*Work/rest*	*Rest-interval activity*
1	60 seconds	5	1:3	mild
2	60 seconds	5	1:3	mild
3	60 seconds	5	1:3	mild

Total time including work and rest is 60 minutes.

1 CONTINUOUS RALLYING (see Figure 9.7 on page 71)

Method: The feeder hits the shuttle anywhere in the court at a fast pace. The feeder can move to different positions for each repetition. The player returns the shuttle to the feeder.

2 SHADOW BADMINTON
Method: The player performs the training routines without a feeder.

3 ROTATION TRAINING
Method: Four players. The players perform the 60-second training time as for Method 1. The players rotate in order: counter, feeder, player, rester. In this way each player performs the work set and then rests for a 1:3 ratio doing mild exercise when he rests prior to acting as counter. It is important that the change of order occur without a break otherwise the time schedule is upset. If time is lost in the changeover it is most impor-tant that the players perform a full 60 seconds' work interval.

4 COMBINED TRAINING
Method: The player can combine repetitions of shadow badminton with continuous rallying.

THE ATP-PC SYSTEM
The routines in this section have a tactical basis and thus involve training sequences directly related to game situations. As this work tends to involve speed, agility and power as the player attempts to hit winners, there is a high probability that the continuous rally method could break down.

The best method for this practice is to use single feeding to the designated court areas. The feeder must learn to feed accurately and at the correct speed. He will need about twelve shuttles available and must be able to hit the shuttles and also to keep an accurate check on the time. It is difficult to use a stop watch when feeding at speed for a short period of time. Fortunately many stores now sell large battery-driven clocks with a second sweep hand, which are quite cheap and excellent for time-checking.

First routine

Training time of 20 seconds. Four sets of 10 repetitions each set. Work/ rest ratio of 1:3 and light exercise in the rest interval. In each set different training sequences will be used though each one will only take 20 seconds to complete according to the schedule set. A full training routine based on a training time of 20 seconds is shown below. The sequences may be altered as the coach and player require. The routine can be written out as follows:

Set	*Training time*	*Repetitions*	*Work/rest*	*Rest-interval activity*
1	20 seconds	10	1:3	light
2	20 seconds	10	1:3	light
3	20 seconds	10	1:3	light
4	20 seconds	10	1:3	light

The total time including work and rest is approximately 54 minutes. Additional time will be added for several minutes rest between each set. Here the player may take up to 3 minutes' rest.

Procedure

The feeder stands in the midcourt on either the forehand or backhand side with 12 shuttles ready. The training time of 20 seconds requires about 8-10 shuttles depending on the speed of the player. The sequence is continuous and involves a smash from the rearcourt and a kill from the net. With practice the feeder should learn to adjust the feeding to enable the player to perform realistically and complete the task without error.

I SINGLE FEEDING

Method: The player smashes straight or cross-court from the forehand or backhand sides and hits a winner from the net on the forehand or back-hand side. The feeder feeds single shuttles to the rearcourt and forecourt

to maintain the player working at speed. The feeder does not try to return the shuttle.

Set 1	*Training Sequence*	*Player*	*Feeder*
Rep. 1		smash straight	in forehand midcourt
Rep. 2 .		smash x-court	in forehand midcourt
Rep. 3		smash straight	in forehand midcourt
Rep. 4		smash x-court	in forehand midcourt
Rep. 5		smash straight	in backhand midcourt
Rep. 6		smash x-court	in backhand midcourt
Rep. 7		smash straight	in backhand midcourt
Rep. 8		smash x-court	in backhand midcourt
Rep. 9		smash straight	in backhand midcourt
Rep. 10		smash x-court	in forehand midcourt

Set 2: The player moves from the midcourt to jump-lunge towards the net to hit a winner and then returns to begin the next sequence.

Set 2	*Training Sequence*	*Player*	*Feeder*
Rep. 1		hit straight	handfeed underarm from forehand midcourt

Set. 2	*Training Sequence*	*Player*	*Feeder*
Rep. 2		hit x-court	handfeed underarm from forehand midcourt
Rep. 3		hit straight	handfeed underarm from forehand midcourt
Rep. 4		hit x-court	handfeed underarm from forehand midcourt
Rep. 5		hit straight	feed from backhand midcourt
Rep. 6		hit x-court	feed from backhand midcourt
Rep. 7		hit straight	feed from backhand midcourt
Rep. 8		hit x-court	feed from backhand midcourt
Rep. 9		hit straight or x-court	feed from backhand midcourt
Rep. 10		hit straight or x-court	feed from forehand midcourt.

Set 3: Repeat Set 1

Set 4: Repeat Set 2

2 SHADOW BADMINTON

3 COMBINE SHADOW BADMINTON AND SINGLE FEEDING

4 GROUP WORK USING FEEDER AND SHADOW BADMINTON
Method: Four players to one court who rotate in order. See page 73. Ensure that each player gets the full 20 seconds work on court.

Second routine
Training time of 10 seconds. Five sets of 10 repetitions each set. Work/rest

ratio of 1:3 and light exercise in the rest interval. In a training time of 10 seconds the player will hit about 5 or 6 shots only. It is important to maintain an accurate check on the time for the rest interval is only 30 seconds and soon runs out when shuttles have to be collected together.

1. Single feeding

Set or rep.	*Training Sequence*	*Player*	*Feeder*
Set 1		smash straight	in backhand midcourt
Set 2		smash straight	in forehand mid-court
Set 3		smash x-court	in backhand midcourt
Set 4		smash x-court	in forehand midcourt
Set 5			
Rep. 1		kill off net	in forehand midcourt-hand
Rep. 2		kill off net	in forehand midcourt-hand
Rep. 3		kill off net	centre midcourt
Rep. 4		kill off net	in backhand midcourt
Rep. 5		kill off net	in backhand midcourt
Rep. 6		kill off net	in centre midcourt
Rep. 7		smash straight	in forehand midcourt
Rep. 8		smash straight	feeder in forehand midcourt

Set or rep.	*Training Sequence*	*Player*	*Feeder*
Rep. 9		smash straight	in backhand midcourt
Rep. 10		smash straight	in backhand midcourt

2 Shadow badminton

3 Combine single feeding and shadow badminton

4 Group work on shadow badminton or single feeding

Third routine
The idea here is to combine different training times. The player could alternate sets of 10-second and 20-second training times. The order of sets could be as follows:

Set 1. 10 seconds x 10 repetitions
Set 2. 20 seconds x 10 repetitions
Set 3. 10 seconds x 10 repetitions
Set 4. 20 seconds x 10 repetitions
Set 5. 10 seconds x 10 repetitions

The training sequences could be selected from those described previously or else new ones could be constructed. The methods would involve either:

1 Single feeding, or
2 Shadow badminton, or
3 Combined feeding and shadow badminton, or
4 Group work on shadow badminton or single feeding

10

Flexibility and Warm-up

Flexibility - or mobility - training ensures that the complete range of move-ment is possible for each of the major joints and muscles. Scientific examination has shown that highly trained people are more flexible than the general population and these same people probably had to work hard to achieve that state. The badminton player who is highly flexible will be able to move more economically because he will be able to turn, twist and stretch with less effort.

Flexibility- or mobility-training also prepares the body for any exercise to follow. This is achieved by ensuring that the full range of movement has been completed before overloading the body. This means that the full extension of the muscles, so necessary for an adequate warm-up, may reduce the chances of muscle and joint injury. The common habit of badminton players to warm up by `knocking up' is not adequate for competitive preparation. It is not uncommon for an inexperienced player to stretch to return a difficult shot during a knock-up and sustain an injury which may have been prevented by a thorough warm-up.

The lack of heating in many badminton halls is an additional reason for paying attention to this. No specialist equipment or extra space is required to warm up and so it should become a regular pre-competition activity. This chapter is divided into three sections:

1 Simple mobility exercises

2 A method of improving flexibility

3 A typical warm-up schedule

SIMPLE MOBILITY EXERCISES

These should be done in a relaxed manner rather than forced with natural, comfortable breathing. Improvement comes by gently increasing the range of movement. Never use sharp movements, and stop if the exercise becomes painful. The exercises need only be performed about ten times at each workout.

Arm-swinging
Start with the feet astride and the arms hanging loosely by the sides. Swing both arms forwards, up-wards, backwards and sideways in a circular motion. Brush the ears with the arms as they go by.

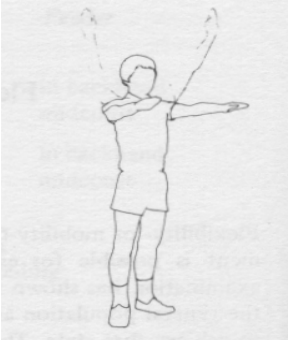


Figure 10.1 Arm-swinging

Side-bends
Start with the feet astride and the hands on the hips. Bend to the left and to the right sides alternately while keeping the head facing forward.

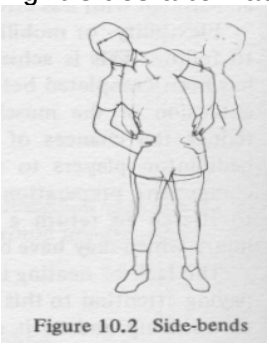


Figure 10.2 Side-bends

Trunk-, knee- and hip-bends
Start in the standing position. Raise the left knee and bring the head down to meet it. Repeat with the right knee. To maintain balance make this a smooth rhythmical movement. The supporting leg can be slightly bent if necessary.

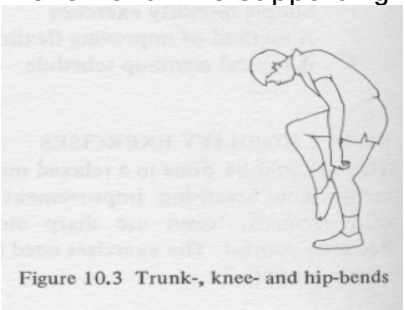


Figure 10.3 Trunk-, knee- and hip-bends

Head-, arm- and trunk-rotating
Start with the feet astride and the hands and arms directly in front at shoulder level. Turn the head, arms and shoulder around to the left as far as possible, bending the right arm across the chest. Repeat the movement to the right always keeping the hips and legs still.

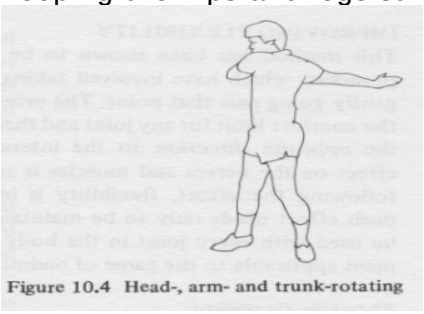


Figure 10.4 Head-, arm- and trunk-rotating

Alternate ankle-stretch
Start with the feet astride and both palms on the front of the upper left thigh. Slide the hands down the front of the left leg, allowing the trunk to relax. Return to the up-right position and repeat on the right side. Do not continue this exercise if there is pain in the lower part of the spine.

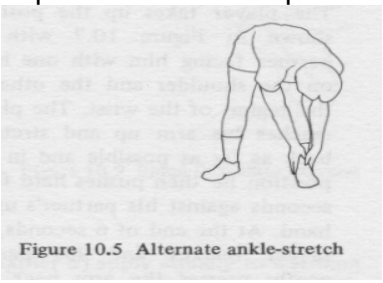


Figure 10.5 Alternate ankle-stretch

Lunges
Stand with the legs wide astride with the right leg directly in front of the left leg. The right foot points forwards and the left foot is turned to point outwards. Keep the rear leg straight and bend the knee of the front leg to lower the trunk into a deep lunge position. Push back to straighten the front leg and return to a standing position. Re-peat this four times and then change over so that the left leg is in front.

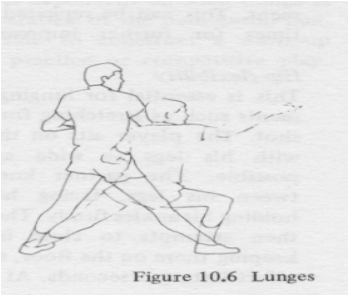


Figure 10.6 Lunges

IMPROVING FLEXIBILITY

This method has been shown to be far more effective than standard ap-proaches, which have involved taking a joint to its comfort limit and then gently going past that point. The principle of this new approach is to reach the comfort limit for any joint and then push against an immovable object in the *opposite direction* to the intended improvement in flexibility. The effect on the nerves and muscles is such that during the relaxation period following the effort, flexibility is increased dramatically. The opposite-push effort needs only to be maintained for 6 seconds. This principle can be used with every joint in the body, but only a few examples, which are most applicable to the game of badminton, will be illustrated.

Shoulder flexibility

The player takes up the position shown in Figure 10.7 with his partner facing him with one hand on the shoulder and the other in the region of the wrist. The player reaches his arm up and stretches back as far as possible and in this position he then pushes hard for 6 seconds against his partner's upper hand. At the end of 6 seconds, the player relaxes and his partner gently presses the arm back and increases the shoulder-joint move-ment. This can be repeated several times for further improvements.

Figure 10.7 Shoulder flexibility exercise

Hip flexibility

This is essential for lunging move-ments such as stretching for a wide shot. The player sits on the floor with his legs as wide apart as possible. The partner kneels be-tween his legs, facing him and holding his ankles firmly. The player then attempts to close his legs, keeping them on the floor, with the effort lasting 6 seconds. At the end of six seconds the player relaxes and the partner pushes his legs further apart to reach a new starting position. The exercise is then repeated several more times.

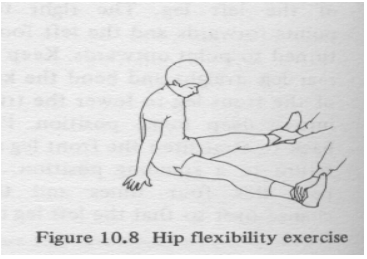


Figure 10.8 Hip flexibility exercise

Spine flexibility

This will allow a greater chance of returning overhead shots and also permit more use of the trunk in the preparation for the smash. The player kneels upright with his partner facing him. He leans back as far as possible and his partner places his hands on the player's shoulders. The player attempts to push for-wards to straighten up for 6 seconds. After 6 seconds he leans further back and the exercise is repeated several more times.

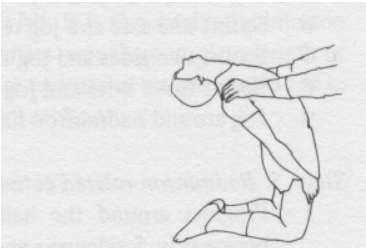


Figure 10.9 Spine flexibility exercise

A TYPICAL WARM-UP SCHEDULE

The general principles of training (see Chapter 6) apply equally to warming up prior to competition. A progressive warm-up is essential (see page 101). The extent and duration of the warm-up is dependent on such things as the fitness of the individual and the temperature of the badminton hall. With experience any player should be able to construct a warm-up programme appropriate to his needs for practice or competitive play.

Stage 1: Mobility exercises

1 Arm-swinging
2 Side-bends
3 Trunk, knee- and hip-bends
4 Head, arm- and trunk-rotating
5 Alternate ankle-stretch

Stage 2: Flexibility improvements

1 Shoulder flexibility
2 Hip flexibility

3 Spine flexibility
4 Other joints as required

Stage 3: Repeat Stage 1.

Stage 4: Running
1 Jog around badminton hall x 3.
2 Stride out one side and jog the remainder.
3 Stride out two sides and jog the remainder.
4 Stride out three sides and jog the remainder.
5 Jog around the hall x 2.
6 Sprint one side and jog remainder.
7 Sprint two sides and jog the remainder.
8 Sprint three sides and jog remainder.
9 Jog around badminton hall.

Stage 5: Badminton-related activities
1 Progress around the hall by sprinting 5 paces forwards, 5 paces backwards, 5 sideways and repeat.
2 Stride 5 paces forward, jump sideways to right and lunge. Return, continue and repeat to the left.
3 Jog around the hall. Every 5 paces jump and smash. Continue this around the hall.
4 On court do shadow badminton starting gently and building up in intensity.

The details of this schedule are not inflexible. The activities can be modified to suit the requirements of an individual player but the different stages give a guideline to thorough warm-up and once learned can be completed without any supervision. This gives the coach an opportunity to work on specific problems with an individual player. As a rule of thumb the warm-up should be sufficiently intense to promote a mild degree of sweat-ing, but after warming up do not stand around allowing the effects to wear off before competing.

11

Strength and Power

As was stated earlier dynamic strength, which involves maximum muscular contraction, is not required in the game of badminton. The player is more concerned with explosive strength or power as seen in the smash or in a jump to gain height before a hit. It is also vital in badminton to maintain the strong and powerful activities over the complete length of the game and thus an element of muscular endurance must be included in the training. The chapter is divided into five sections:

1 Safety factors
2 Basic strengthening activities
3 Strength-training circuit
4 Further strength-training activities
5 Badminton-related activities

SAFETY FACTORS

Lifting anything can be dangerous so it is essential to establish a `code of practice' before starting to train for strength, particularly if weight-training. Most of the safety factors are common sense but it is essential to make sure that all the players are thoroughly aware of them before proceeding. A copy of these should be posted on the club notice board. Though specific weight-training is not discussed or explained as a method of training in this book, owing to the necessity for expert guidance on using weights, it is important for those players who do use weights to follow the advice written below.

1 Always train with other people.
2 Thoroughly warm up before handling weights.
3 Always ensure that the weights to be lifted are within your capability.
4 Remember that returning a weight to the floor is a lift in reverse and requires just as much control as lifting it up.
5 Ensure that all the weights are secured to the bar before lifting.
6 When handling weights always have a partner ready to assist if necessary.

7 Breathe naturally during the exercises. (Weightlifters consider that the best breathing technique it to take a deep breath at the beginning of the contraction, hold it for a few seconds, then exhale slowly during the latter part of the contraction.)
8 Always lift with a straight back, eyes forward and head up.
9 Competitive weight-lifting, even in an informal manner, has no place in training for badminton, so never try to `prove your strength' in this way.
10 Avoid moving those parts of the body not being strengthened in any given xercise.

BASIC STRENGTHENING ACTIVITIES

These activities serve as a useful check before you progress to other forms of strength-training. If any of these activities are difficult then spend several weeks working on one of them alone and only continue when all can be completed with ease. They can all be done in the home but remember to warm up first. The exercises should be performed with a smooth continuous rhythm.

Press-up(Modified)
1 WOMEN

Start with the hands shoulder-width apart resting on a sturdy table. Bend the arms until,the chest touches the table while keeping the body straight. Push up to starting position.

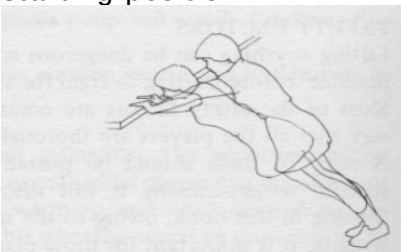


Figure 11.1 Modified press-up for women

2. MEN

Proceed as above but using a sturdy chair or bench.

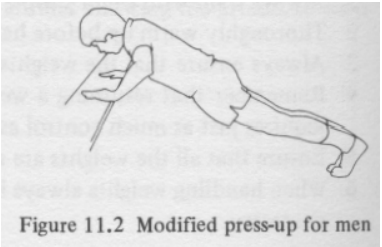


Figure 11.2 Modified press-up for men

Sit-up

1 WOMEN

Sit on a chair or bench holding the sides of the seat. Lift the legs, hold for a few seconds and return to the starting position. The legs may be bent or straight.

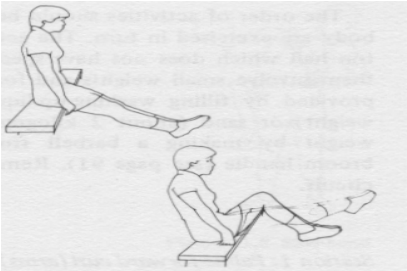


Figure 11.3 Sit-up for women

2 MEN

Lie on the back with the hands behind the head, legs slightly bent and feet tucked under a heavy piece of furniture. Sit up to touch the head to the knees and return to the start position.

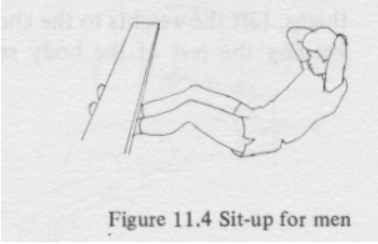


Figure 11.4 Sit-up for men

Squat

Start in standing position. Squat to rest on haunches and return to the starting position.

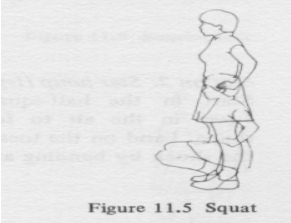


Figure 11.5 Squat

STRENGTH-TRAINING CIRCUIT

A circuit to develop strength with local muscular endurance can be laid but around the edges of a badminton hall so that the playing area is not affected. In clubs where the number of courts is limited the players could take part in the circuit while waiting for a game.

The order of activities should be arranged so that different parts of the body are exercised in turn. The activities listed are suitable for a badmin-ton hall which does not have specialist gymnastic equipment. Certain of them involve small weights and for the strength-training circuit these are provided by filling washing-up-liquid bottles with water (1 kilogram in weight) or sand (about 2 kilograms in weight). One can use a heavier weight by making a barbell from two one-gallon containers and a broom handle (see page 91). Remember to warm up before starting the circuit.

Station 1: Palms forward curl (arms)

Stand upright holding the bottles or barbell resting on the front of the thighs. Lift the weights to the chest, keeping the rest of the body still.

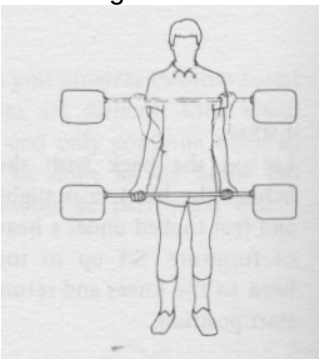


Figure 11.6 Palms-forward curl

Station 2: Star jump (legs)

Start in the half-squat position. Jump in the air to form a star-shape. Land on the toes and absorb the shock by bending at the knees.

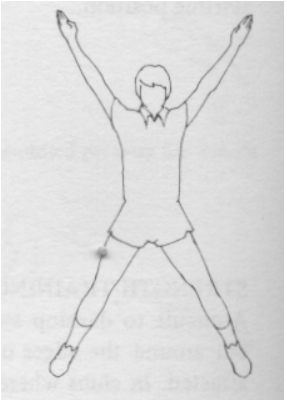


Figure 11.7 Star-jump

Station 3: Side-bend (trunk)
With feet astride, hold a bottle in the right hand with the left hand on the hip. Bend to the right as far as possible and then bend to the left. Perform 10 repetitions with the bottle in the right hand and then change hands and repeat.

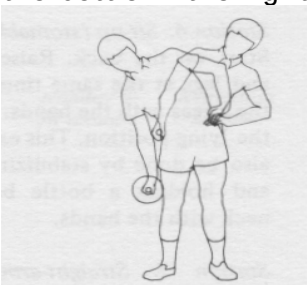


Figure 11.8 Side-bend

Station 4: Bench-press (arms)
Lie on the back with a barbell or bottle held in each hand resting on the chest. Straighten both hands together so that the weight is pushed up vertically. Return to the chest and repeat.

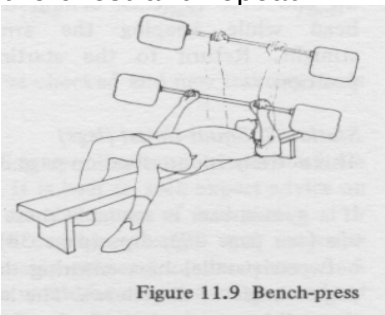


Figure 11.9 Bench-press

Station 5: Bench jump (legs)
Start with the feet astride a bench. Jump up to bring both feet on the bench. Jump down to return to the starting position. Do this continuously.

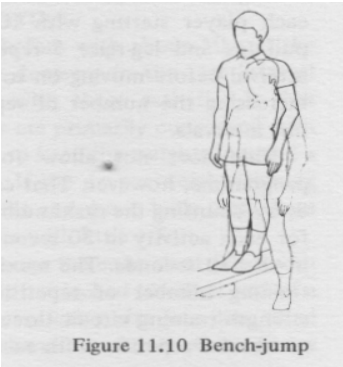


Figure 11.10 Bench-jump

Station 6: Sit-up (stomach)

Start on the back. Raise the arms and legs at the same time to touch the knees with the hands. Return to the lying position. This exercise can also be done by stabilizing the legs and holding a bottle behind the neck with the hands.

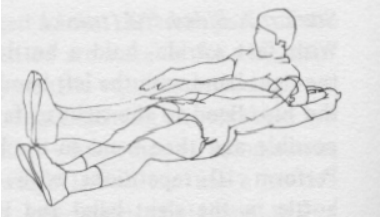


Figure 11.11 Sit-up

Station 7: Straight-arm pullover (arms)

Lie on the back with the bottles resting on the thighs. Lift bottles up and over to teach behind the head while keeping the arms straight. Return to the starting position.

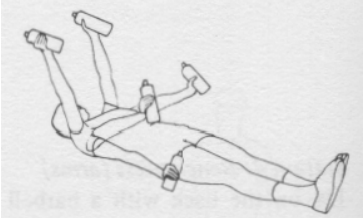


Figure 11.12 Straight-arm pullover

Station 8: Squat-thrust (legs)

This activity is described on page 33. See Figure 4.2.

If a gymnasium is available these exercises can be supplemented by pull-ups (see page 37), dips (page 38) and leg-raises. Dips can be completed between parallel bars ensuring that the body is lowered to make a *90*-degree angle at the elbows. The leg-raise is best achieved by hanging from the wall bars and raising the legs until horizontal with the floor.

Organization of the strength-training circuit can be made simple by each player starting with 10 repetitions on each activity. For the dips, pull-ups and leg-raise 5 repetitions is adequate. Allow an adequate rest interval before moving on to the next activity. Progression is achieved by increasing the number of repetitions on each activity and decreasing the rest intervals.

This does not allow for an individually tailored strength-training programme, however. That can be established, as in the circuit in Chapter 8, by counting the maximum number of repetitions that can be completed for each activity in 30 seconds. For example, a player may do 30 sit-ups in the 30 seconds. The maximum number is then halved to establish the training number of repetitions for sit-ups. The player completes the strength-training circuit three times continuously, completing the training number of repetitions for each activity. Periodically the maximum number of repetitions that can be performed is rechecked and new training levels established.

Activity-Circuit Record Card

Name .....

Station	*Activity*	*Number in 30 seconds*	*Repetition number*	*Number in 30 seconds*	*Repetition number*
1	Palms-forward curls				
2	Star-jumps				
3	Side-bends				
4	Bench presses				
5	Bench jumps				
6	Sit-ups				
7	Straight-arm pullovers				
8	Squat-thrusts				
		Date	*Time*	*Date*	*Time*

A detailed programme of weight-training requires combinations of the correct number of repetitions and sets. It is best to seek expert advice on weight-training schedules appropriate to the sport of badminton. For example, the optimum combination to develop strength and muscular endurance simultaneously would be 3-4 sets with each set containing 5-6 repetitions. The load for each repetition would be near the maximum load that can be lifted for that set.

FURTHER STRENGTH-TRAINING ACTIVITIES

The repetitions for these activities start as before with about 10 and the number can be built up with a progressive decrease in the rest interval between each activity. Another difference with these activities is that heavier weights can be used. However, as we are primarily concerned with strength related to endurance, it is necessary to keep the weights low and a maximum weight of 30lbs is recommended. If the proper weight-training equipment is available in the form of barbells and dumb-bells then these are ideal, but suitable alternatives can be made with little effort .

A one-gallon plastic orange juice container or the equivalent filled with water or sand makes an excellent barbell when attached to either end of a broom handle. Alternatively the one-gallon catering size jam tins filled with cement and with the ends of a broom handle sunk into each one are relatively cheap to make

All the activities using the bottles that were outlined in the previous section could be completed with a modified barbell or dumb-bell. It is advisable to make up a range of weights and always try every activity with the lightest weight to ensure that it can be completed with good style. Remember to warm up before attempting these activities.

Chin-high pull
Bend the knees to grip the bar at shoulder-width apart with the toes underneath the bar, about 10 inches apart. Keep the back straight whilst leaning forwards and ensure that the knuckles face forward. Stand up while pulling the bar in a straight line close to the body until the bar is under the chin. Return to the starting position by lowering the bar to the thighs and then bending the legs to place it on the ground.

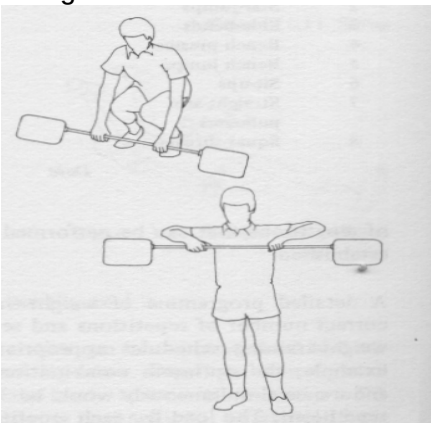


Figure 11.13 Chin-high pull

Press behind neck
Stand upright with the bar resting across the back of the neck and shoulders. Extend the arms fully and return to the start.

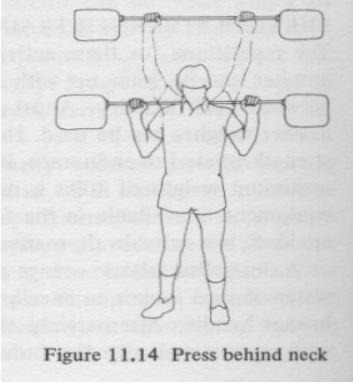


Figure 11.14 Press behind neck

Squat

Stand with the feet about 10 inches apart and with the barbell behind the neck on the shoulders. Bend the knees until the knee joint makes an angle of no more than 120 degrees, then drive upwards to a tip-toe position. Lower the heels to the starting position with the feet flat on the floor. A good indication of the correct amount to bend the knees is to imagine that you are sitting on a high stool. In fact, actually to sit down on a high stool is a good safety feature.

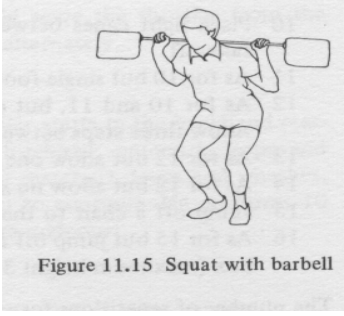


Figure 11.15 Squat with barbell

Clean and press

The starting position is as in the chin-high pull (see opposite). The body is extended and the bar pulled up close to the body until it rests on top of the chest. The bar is pressed overhead to arm's length. Return to start by lowering the bar to the chest, then to the thighs, and then bending the legs to lower it to the floor.

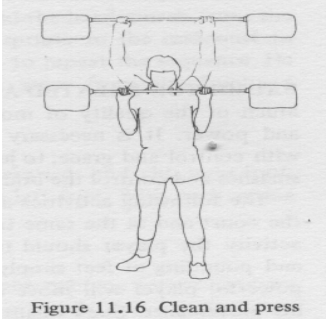


Figure 11.16 Clean and press

Bounding

This activity is excellent for developing leg-power. It involves a variety of continuous high stepping and jumping movements:

1 Right-leg hopping.
2 Left-leg hopping.
3 Hopping with emphasis on height not length.
4 Double foot take-off jumping for length.
5 As 4 but emphasis on height.
6 Bunny hops to squat for length.
7 Bunny hops to squat for height.
8 Series of long steps (changing feet) for length.
9 Series of steps for height.

10 Place light canes between chairs and jump over with double-foot take-off.
11 As for 10 but single-foot take-off.
12 As for 10 and 11, but over a series of canes in a line (at least five). Allow three steps between each cane.
13 As for 12 but allow one step between each cane.
14 As for 12 but allow no steps between each cane.
15 Jump off a chair to the floor and bound immediately over a cane.
16 As for 15 but jump off a higher object such as a table or gymnastics box (maximum height 3 feet).

The number of repetitions for each activity can start as low as 10 but build up progressively.

BADMINTON-RELATED ACTIVITIES

Much of the quality of movement in the game is dependent on strength and power. It is necessary to move, stop and change direction quickly with control and grace; to jump and land with lightness; to make powerful smashes and control the body while playing a delicate touch shot.

The following activities are designed to develop strength and power on the court and at the same time to promote quality of movement. In each activity the player should try to move softly on his feet. Heavy landings and pounding of feet simply indicate a lack of strength and control. The powerful player will move lightly over the floor and appear effortless in his movements. Such quality can be developed with strength if practised from the start. The rule should be `soft feet' in all movement.

Continuous smashing

Feeder and player. The feeder begins in the midcourt and feeds shuttles continuously to the player. This takes some practice before the feeder can regulate the pace with accurate feeding. After 10 smashes change over.

Rebound jump smashing

Perform with or without a feeder. The player stands astride the centre-line in the midcourt. He jumps off two feet to smash the shuttle from the forehand side, lands and jumps back to the centre. Immediately he jumps to the backhand side to perform a round-the-head smash, lands and jumps back to the centre. He repeats this until 10 smashes have been performed.

If a feeder is used then the feeder should serve the shuttles from the centre midcourt to the right and left courts alternately.

Running jump smash
Perform with or without a feeder. The player starts in the backhand rear-court corner. He sprints across to the forehand rearcourt, leaps and smashes, lands and sprints to the backhand rearcourt, leaps and smashes, lands and sprints to the forehand rearcourt to continue. He performs 10 smashes. Feeder should serve from the centre midcourt.

Running backward jump smash
With or without feeder. The player starts in the attacking stance in the midcourt. He pivots round sideways on to the backhand rearcourt, side-steps and leaps backwards to perform a round-the-head smash from the backhand rearcourt; lands and immediately sprints to the midcourt to stop in balance, in the attacking stance, ready to repeat the sequence. He performs 10 repetitions. The feeder should serve from the forehand midcourt.

Alternate leg-springing
The player stands on his left foot and springs forwards on to his right foot, lands and pushes off to spring back on to his left foot. With each spring try to increase the distance. Perform 10 jumps.

Lunge jumps
The player stands in the attack position with the right leg forwards, knees slightly flexed. He jumps forward to land on both feet in the lunge position then sways back on to the left leg and brings the right leg back to the attack position ready to repeat the lunge-jump. Perform 10 lunge-jumps, each time trying to increase the distance.

Running lunge jumps
Repeat as for lunge jumps but sprint several steps before lunge jumping.

Lunge to kill off the net
Perform with or without a feeder. Stand on the edge of the forecourt with the rear foot behind the short service-line. Lunge-jump upwards to kill off the net, land and spring back to the starting position. Perform 10 lunge-jumps. The feeder should stand on the short service-line and throw the shuttle just over the net in a darts-throwing action.

Wide squat jump
This exercise helps to develop the ability to move quickly forwards, back-wards or sideways from a defensive stance. Stand with the legs apart in a deep squat position with the trunk upright. Leap forward and backwards 10 times. Leap alternately to the right and left 10 times, each time landing in the deep squat position with the legs wide apart.

Skipping
This is a form of exercise used by many players to develop footwork. It can help to develop the quality of lightness of movement (softness of foot) so necessary for alertness, control and balance. It can also be used to develop leg-power when performing skip-jumps.

1 SKIPPING FOR LIGHTNESS
Skipping is enjoyable if one gets into a rhythm and for this steady rhythmic music is excellent. There are several methods of skipping. One is to skip to 100 turns of the rope and then rest a minute. Repeat this until l,000 turns have been completed.

A second method is to skip for a certain length of time and rest for an interval. Skip for 5 x 2 minutes with a 1-minute rest interval. The work period can be increased as one becomes fitter. A third method is to skip without a pause for 10 minutes. During the skipping maintain the rhythm and remain light on the feet.

2 SKIPPING FOR POWER
Skip using double-foot rebound jumping as the rope turns. Jump off two feet high in the air and bring the knees quickly up to the chest while turn-ing the rope as many times as possible during the jump, land and rebound to repeat the jump. Try to perform 5 high rebound jumps continuously and build up to 10 jumps before resting.

PART FOUR

The Training Programme

12

Planning a Programme

The ultimate concern of this book has been with preparation for competi-tion. The purpose of any training is to make it possible to achieve the desired goal of success in competition. A good training programme will make the body more efficient and thus must develop fitness to the level necessary to meet the work demands of the game. There is much need for further study in this area. In the meantime, until further research is undertaken, we have attempted to examine the information on fitness-training that is available and apply it to the game.

The principle of individual specificity would indicate that careful consideration must be given to the actual selection of training work particularly with regard to on-court training. In this area the routines involve the selection of training sequences designed to develop fitness in particular situations which arise from the technical/tactical requirements of the player. Ideally strength-training and aerobic endurance-training should be developed over a number of years rather than months because the body continues to adapt even after a long period of training.

No detailed programme can be provided because availability of time, facilities, attitude and level of fitness will vary from individual to individual. However, it is possible to provide a structure of a year-round programme and suggest how the different components can be balanced to contribute to the improvement of performance. In addition, some examples have been provided of the type of training programme that might be followed by different levels of player. Before looking at different training schedules there are two main areas to consider. Firstly, some general considerations in planning a programme and secondly, the specific design of a programme.

GENERAL CONSIDERATIONS

Medical Advice

1 CHECK-UP

Before embarking on any demanding training programme it is advisable to have a medical check-up. This is particularly important for the older

athlete who has not trained for several years or who has not trained previously. It is very important for players of any age to do so where there is a history of illness with regard to the heart and lungs.

2 INJURY

One of the consequences of almost any sporting activity is the risk of injury. It is not appropriate to discuss details of injuries or treatment in this book but the principle of adequate rest is a sound general treatment. There is no point in attempting to push through the pain barrier in training if pain is the result of injury, because pain is the body's method of warning you to stop. The pain caused by lactic acid build-up in the muscles is a separate non-injury event and training will build up a tolerance for this over a period of time.
The most common forms of badminton injury are probably twists and sprains which cause immediate swelling. The swelling can be effectively reduced with rapid first-aid treatment. The recommended treatment is ice, compression and exercise. An ice-pack placed on the site of the injury (for not more than a 15-minute period) and a compression bandage and mild exercise will help. For more serious injury consult a doctor immediately. It is invaluable for a club or player to know which doctors in the area are knowledgeable about sports injuries and sympathetic towards injured sportsmen. The British Association of Sport and Medicine represents a number of doctors, physiotherapists and physical educationists who are concerned with sports injuries.

3 COLDS

There is medical evidence to suggest that it is not advisable to carry out physical activity while suffering from the effects of a bad cold or an influenza-type of infection caused by a virus. The old idea of sweating out such infections by hard physical activity is not recommended. The best advice is to rest until you are ready for activity and then commence with a session of light training.

Sex differences

There are differences in muscular-strength development and aerobic capacity after puberty which give men a greater fitness capacity in com-parison with women in most sports. However there are no reasons why women cannot participate in a rigorous programme of fitness-training modified to their needs.

Age differences

These days young athletes in many sports appear to start at an earlier age and adopt intensive training routines when very young. Examples of this can be seen in such sports as swimming, gymnastics and ice-skating. There would appear to be no physiological reasons why young players from 10-15 years could not take part in a moderate fitness-training programme.

However, there are other considerations when planning a programme. Fitness in badminton is directly related to skill in that any fitness is superfluous and becomes redundant unless the player's level of skill creates a game that contains a work load which requires a particular level of fitness. In brief, as a player becomes more skilful so the competition level becomes higher and the player must become fitter. Young players may well be advised to spend time in practice and play in order to improve the skills component. If they do this and participate in other activities in the school PE programme they should develop a good level of fitness. It is most unlikely that they will be able to compete at the higher levels until they are in their late teens and by that time the skills should be highly developed and time can be spent on fitness-training.

It is also important that young players enjoy the game. Too systematic and rigorous a training programme can destroy this enjoyment. It is noticeable that many successful teenage swimmers drop out because the work demands spoil their enjoyment and interest in the sport. In their case there is such a close connection between skill and fitness development that they become interdependent and the young swimmer has no choice but to train hard. Fortunately this is not the case with the badminton player.

In general, continued participation and interest in badminton is best served if enjoyment is considered a priority in the early years. For those young players who do enjoy training a programme can be devised which, if in accordance with the principles of training, should result in a beneficial training effect.

Warm-up

There is still some debate over the relative merits of warming up even though most scientific studies confirm the practical experience of athletes that warm-up is beneficial. Warm-up raises the muscle temperature, increases the effectivness of the muscular contraction and also gives a general boost to the cardiorespiratory condition of the body. The body is thus better prepared for activity and the risk of injury is lessened. Warm-up in badminton is often replaced by the knock-up. The problem with this is that in the early stages of knocking up the muscles are not adequately

warmed and a determined stretch to play back a shuttle just to keep it going can often cause injury. It is better to leave the related form of warm-up such as shadow badminton, stroke repetitions and knocking up until an unrelated form of warm-up has been completed. This could involve flexibility exercises and jogging, building up to short sprints and eventually longer sprints. This is particularly important in cold badminton halls where a longer warm-up may be necessary.

After competition it is equally important to warm down effectively. Far too many players finish their game and sit down without even taking the trouble to put on a track-suit. The body feels hot after play and very soon adjusts to the lack of activity. However, the temperature-controlling mechanism may continue and loss of body heat may cause an impaired performance later. A lot of heat is lost from the head and neck region and this is why track-suits with hoods are preferable, particularly for playing or training in cold places.

As many players will be playing again later it is advisable to speed up the recovery process by an active form of warm-down. This involves light activity such as flexibility exercises and jogging for a few minutes after the end of a game.

Time spent on training

It is inevitable that for various reasons some players will be able to train more than others. The question arises as to how much time should be spent in training. Training effect is related to intensity and time spent in training. Therefore, if the time available is limited the intensity should be high. Even with a minimal training load the principle of adaptability will necessitate a progressive overload irrespective of the time spent on training. How much time should be spent is dependent on the level of play to which the player aspires. For this some experimentation is necessary to find the correct training level to force adaptation for each fitness component.

General Nutrition

It is known that calorie intake in the form of food and drink and calorie output in the form of physical activity are interdependent in maintaining a desirable weight. An active badminton player, training hard might consume 5,000 calories per day without putting on excess weight. An inactive person with otherwise similar characteristics would soon become obese if he ate at this daily rate.

In general, a player requires the same balance and variety of foods as anyone else. Each day he should have adequate amounts of:

1 bread and cereals (preferably wholemeal bread)
2 meat or meat alternatives
3 milk and milk products
4 fruit and vegetables

Foods not included in these groups, such as butter, margarine and sugar, when used with these foods, or in cooking, supply additional nutrients. It is not generally accepted that any specific food or vitamin products can in themselves improve playing performance. Any supposed benefits are more likely to be of a psychological nature. There is evidence from research to indicate a need for a wholesome breakfast. Almost without exception, studies have shown that breakfast makes a difference to sporting performance. There is also experimental evidence to show that sportsmen need at least three good meals each day for optimum performance. More frequent spacing out of meals might be desirable in certain circumstances. The young player who is still growing will very often take a snack some time during the afternoon and another later in the evening.

ADDITIONAL CONSIDERATIONS

In hot conditions there should be a periodic replacement of water lost in sweating. It is best to limit intake of water during an actual training session to a quarter-pint. In very hot conditions there will be a need to replenish salt daily and in this respect, except in extreme cases, salting of foods at mealtimes should be adequate.

Recent research suggests that for long-term activities such as badminton an emphasis on carbohydrates produces a readily available source of energy. In comparison a high-protein diet serves no useful purpose, the quantities available in a normal diet being quite adequate. In activities of a strenuous nature there is an increased utilization of available carbo-hydrates. The body adjusts itself to the needs and utilizes the content of the food naturally. Protein is not a chief source of muscular energy.

Pre-match meal

A gap of 3-4 hours is recommended between the last meal and competition. Although this will vary with individuals, it is considered that this time-lag is necessary to allow complete digestion. The emotional effects of pre-competition are far less acute when the last meal is taken well in advance.

Except for prolonged events of several hours, efficiency is improved little by the pre-match meal. It must be remembered that, in tournament play, several rounds could be held sufficiently close to each other to prevent an adequate meal from being digested. The remedy for this is to take a small, palatable, high-carbohydrate meal between rounds. Some of the proprietary high-carbohydrate drinks are specially constituted for this purpose.

As there are many misconceptions about food some useful information is provided in Appendix II.

DESIGNING THE PROGRAMME

The aim of the programme

You should consider all aspects before planning a suitable programme. The first task is to decide the aim of the whole programme. The aim is usually to defeat a particular player, make the team, or to win a particular tourna-ment. The measure of improvement in performance is the success in achieving that aim. Factors such as skill, fitness and knowledge of the opponent should be considered. Particular forms of training and different skill practices make up the programme. So to start with, select your aim and decide what sort of work is necessary to achieve it.

Duration of the programme

The target may be anything from 6 months to 1 year ahead. The programme must encompass the complete period. For this reason it is unwise to be too rigid. Players are not machines and the programme requires constant evaluation and modification. Allow for a flexible frame-work for the programme.

Progression

There are both logical and psychological considerations in planning any programme. The coach will be wise to reflect on these before commencing. Certain skills presuppose the possession of others. For example one would not expect a player to assume a forward base in singles and take the shuttle early if he did not possess the speed or the strokes to do so. Nor would one expect the player to smash from the rearcourt and then cut off the return at the net without speed deriving from strength and power. It would be unwise to expect standards of excellence at the end of a long match unless the player was fit enough to maintain the pace. The develop-ment of fitness is a gradual affair and involves the correct balance between quantity and quality.

It is inevitable that some psychological considerations arise in the

development of a player's game. To ask too much from the player in the early stages, to get him to attempt work for which he is not capable and to expose him to failure, and hence frustration at his lack of ability, can result in a loss of confidence in himself and his coach. Unrealistic expecta-tions of a tactical/technical kind leading to failure can cause a reluctance to work at the game and seriously affect the fitness-training programme. This sort of reaction is often encountered in teaching: if the work is too easy boredom arises, and if it is too difficult frustration occurs. Develop-ment is gradual, and the player will benefit and his confidence will grow if he sees and feels an improvement in skill and fitness.

For these reasons the work may be divided into phases which lead towards the aim of the programme. A typical example is shown below.

Pre-season

Phase 1 August

Aerobic training with the emphasis on cardiovascular and respiratory endurance components.

Assessment of individual strengths and weaknesses of the fitness components.

Basic strengthening activities.

Improvement of flexibility.

Introduction of new hitting techniques or methods of moving on the court.

Learning and practice.

Phase 2 September

Continue aerobic training.

Correction of poor performance in fitness components assessed in Phase 1.

Strength-training circuits.

Basic skill-training.

Competition Season

Phase 1 October

Maintenance of aerobic fitness by training this energy system at least once per week.

Training for both energy systems by circuit-training and other activities (see Chapter 8).

Continue strength-training circuits.

More emphasis on skill-training.

Increase on-court and related training practices, e.g. stroke practices and sequence work on the court. The new skills can be placed into pressure situations incorporated into games play and conditioned games.

Retest on fitness-component levels.

Phase 2 November/March
Greater emphasis on training the anaerobic energy systems, i.e. shorter, intensive, interval-type work.
High pressure on-court work and related training practices. Great emphasis on skill-training sequences.
Further strength-training activities.

Throughout the whole period maintain regular checks on the programme. Fitness can be measured regularly by the methods already explained. The player's weight and diet require constant observation and due concern should be paid to the general feeling of well-being of the player. This is important and the player is the best judge of this condition. If he feels stronger, quicker and more alert, then it is usually a good indication that the programme is well balanced. A player who feels jaded, tired and discouraged or is generally unhappy with the way he feels demonstrates quite clearly that the programme is not adequate for his individual needs. Each player is a unique individual and it is well to remember this when constructing a programme.

End of Season

April/Judy
Maintenance of aerobic fitness levels by alternative activities such as swimming and other sports.
Skill-training in specific weaknesses in preparation for next season. Medical check-up, dental treatment and inoculations.
Active relaxation during the closed season.
This is an ideal time with the availability of salads and fresh fruit to establish correct body weight.

RECORDING PROGRESS

Training Diary
It will be obvious that planning a training programme is a complex business. It is necessary to keep a record of the work completed. One way of doing this is to keep a training diary in which the overall programme can be written and progress recorded for instant reference when periodically assessing the programme.

Summary Chart of Seasonal Training Programme

	Pre-season		*Competition season*		*End of season*
	Phase 1	Phase 2	Phase 1	Phase 2	
	August	September	October	November-March	April-July
Aerobic/cardiovascular and respiratory endurance	*	*	*		*
Aerobic and Anaerobic/ local muscular endurance			*		
Anaerobic/speed				*	
Basic strengthening	*				
Strength/power circuit		*	*	*	
Further strength activities				*	
Evaluation of fitness components	*		*		
Agility		*	*	*	
Flexibility	*	*	*	*	
Correct body weight					*
Skill training	*	*	*	*	*
Medical/dental attention					*
On-court training			*	*	
Active relaxation					*

It also shows whether the player has achieved his training objectives. Details of fitness-component scores, competition results and general bodily feelings can be recorded in addition to the training programme. A diary of this sort is extremely useful, for, if maintained over a number of years, the information recorded makes the adjustment to training loads for individual programmes an easier task.

Levels of progress

In any training programme an unfit person will have much greater success early on in his training than later when he gets fitter. This is because increase of fitness and length of training is not linearly related but approxi-mates to the curve in Figure 12.1.

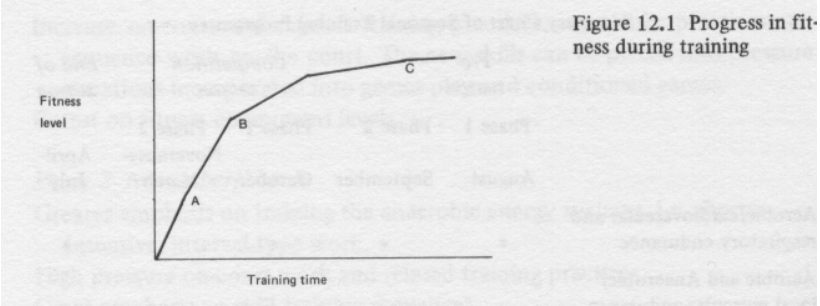


Figure 12.1 Progress in fitness during training

It can be seen that a person starting with a low level of fitness as point A on the curve will show a good increase in fitness in the early part of his training. After a further training time when he reaches point B on the curve, fitness levels will increase much more slowly. A highly fit person at point C needs to train both hard and long for any increase in fitness. However, at that level, with all other things being equal, marginal levels of fitness may be all that are required to win the major tournament, so the investment is often worth it.

13

Training Schedules

It is extremely difficult to write specific individual training programmes in a book and for this reason we have provided sufficient information to enable any individual player to plan his own training programme. However, to do so requires some careful thinking and arrangement of the components of a programme. It might be useful, therefore, if a few sample programmes for different levels of play were illustrated. The following examples should by no means be copied rigidly, but will, it is hoped, act as a guide to individual variation. In selecting three levels of player, club, county and tournament/international, attention is focused on the increasingly progres-sive quantity and intensity of work operating at these three levels and the sort of work that is appropriate at each level.

On-court training is ideal throughout much of the programme but it is realized that the availability of courts in badminton clubs is limited and consequently off-court training will be outlined throughout. Those players with the facilities should modify the following programme to include on-court training. It is expected that international-type players will have access to facilities in sports centres and be able to complete the appropriate on-court training.

CLUB PLAYER

Pre-season (August/September)

Aim: To develop the oxygen system, flexibility, strength, power and agility

Number of days per week: 2 days

Time available each day: 30 minutes

Training routines:

Days 1 and 2

Warm-up including flexibility	5 minutes
Fartlek run 12 minutes	12 minutes
Simple strength circuit	5 minutes
Warm-down	2 minutes

Early season (October/November)	
Aim: To maintain oxygen system and develop lactic acid system	
To maintain flexibility and agility, improve strength and power and increase speed	
Number of days per week:	2 days
Time available each day:	30 minutes
Training routines:	
Day 1	
Warm-up including flexibility	5 minutes
Quality run. 3 x 4 minutes with 2-minute rest interval	16 minutes
Shadow badminton. 3 x 2 minutes with 1-minute rest interval	9 minutes
Day 2	
Skipping. 5 x 1 minute with 30-second rest interval	7 minutes
Quality run. 3 x 2 minutes with 4-minute rest interval	18 minutes
General circuit-training	5 minutes
Mid-season (December/January)	
Aim: To develop the lactic acid and ATP-PC systems	
To maintain the other fitness components	
Number of days per week:	2 days
Time available each day:	35 minutes
Training routines:	
Day 1	
Warm-up, flexibility.	5 minutes
Run. 5 x 1-minute with 3-minute rest interval	20 minutes
Skipping. 3 x 2 minutes with 1-minute rest interval	9 minutes
Day 2	
Warm-up, flexibility	5 minutes
Shuttle-run. 9 x 15 seconds with 45-second rest interval	9 minutes
Warm-down	5 minutes
Repeat shuttle-run	9 minutes
Strength circuit	5 minutes
Late season (February/March)	
Aim: To develop the ATP-PC system	
To maintain the other fitness components	
Number of days per week:	2 days
Time available each day:	30 minutes

Training routines:
Day 1

Warm-up and flexibility	5 minutes
Training sequences with or without feeder (shadow badminton) *or* shuttle-runs if court not available	
15 x 20 seconds with 1-minute rest interval	20 minutes
General circuit	5 minutes

Day 2

Warm-up and flexibility	5 minutes
Skipping. 5 x 1 minute with 30-second rest interval	8 minutes
Training sequences with or without feeder (shadow badminton) *or* shuttle-runs if court not available	
18 x 10 seconds with 30-second rest interval	12 minutes
General circuit	5 minutes

COUNTY PLAYER
Pre-season (August/September)
Aim: To develop the oxygen system, flexibility, strength, power and agility

Number of days per week:	3 or 4 days
Time available each day:	45 minutes

Training routines:
Days 1 and 3

Warm-up and flexibility	5 minutes
Run. 30 minutes at steady pace	30 minutes
Warm-down	5 minutes
Simple circuit	5 minutes

Days 2 and 4

Warm-up and flexibility	5 minutes
Fartlek run. 30 minutes	30 minutes
Warm-down	5 minutes
Simple circuit	5 minutes

Early season (October/November)
Aim: To maintain oxygen system and develop the lactic acid system
To maintain flexibility and agility and improve strength and power and increase speed

Number of days per week:	3 days
Time available each day:	45 minutes

Training routines:

Day 1

Warm-up and flexibility	5 minutes
Run with 2½-minute rest interval. 3 x 5 minutes	20 minutes
Shadow badminton. 5 x 2 minutes with 1-minute rest interval	15 minutes
Simple circuit	5 minutes

Day 2

Warm-up and flexibility	5 minutes
Fartlek run. 15 minutes	15 minutes
Warm-down	5 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes
General circuit	5 minutes

Day 3

Warm-up and flexibility	5 minutes
Run. 6 x 2 minutes with 4-minute rest interval	32 minutes
Warm-down	5 minutes
General circuit	5 minutes

Mid-season (December/January)

Aim: To develop the lactic acid system and ATP-PC system
To maintain the other fitness components

Number of days per week:	3 days
Time available each day:	45 minutes

Training routines:

Day 1

Warm-up and flexibility	5 minutes
Run. 5 x 1 minute with 3-minute rest interval	20 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes
General circuit	5 minutes

Day 2

Warm-up and flexibility	5 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes
Shadow badminton 5 x 1 minute with 3-minute rest interval	20 minutes
General circuit	5 minutes

Day 3

Warm-up and flexibility	5 minutes
Fartlek run. 20 minutes	20 minutes

Shadow badminton. 5 x 1 minute with 3-minute rest interval	20 minutes
Late season (February/March)	
Aim: To develop the ATP-PC systems	
To maintain the other fitness components	
Number of days per week:	3 days
Time available each day:	45 minutes
Training routines:	
Day 1	
Warm-up and flexibility	5 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes
Training sequences with or without feeder *or* shuttle-runs if court not available. 15 x 20 seconds with 1-minute rest interval	20 minutes
General circuit	5 minutes
Day 2	
Warm-up and flexibility	5 minutes
Training sequences *or* shuttle-runs. 30 x 10 seconds with 30-second rest interval	20 minutes
Warm-down	5 minutes
Training sequences *or* shuttle-runs. 20 x 10 seconds with 30-second rest interval	14 minutes
Warm-down	5 minutes
Day 3	
Warm-up and flexibility	5 minutes
Training sequences. 12 x 20 seconds with 1-minute rest interval	16 minutes
Warm-down	5 minutes
Training sequences. 18 x 10 seconds with 30-second rest interval	12 minutes
General circuit	5 minutes

THE TOURNAMENT/INTERNATIONAL PLAYER

The potential international player, whether an amateur or professional, must allow much time to train and practise if the aim is successful perfor-mance in competition. The time spent on training gradually decreases as the international tournament and match commitments increase. Ideally the international might spend up to three hours each day divided between practice and training. At this level there is a greater need for an individually

tailored programme which can be adapted to the various competitive commitments throughout the year and which is regularly assessed and modified.

Another feature of the work is the difficulty in providing variety, for when one has to work up to 1 1/2 hours each day in training it soon becomes painfully obvious that, no matter how varied the programme is, the monotony of work remains. This is something that the player has to come to terms with and so he must discipline himself to work hard and push himself continuously in accordance with the principle of overload.

It will also be necessary to space out the training time for it is doubtful whether quality work can be maintained over a continuous period of up to $1^{1}/2$ hours. For example, after a 30-minute quality run it will not be possible to play 20 minutes' shadow badminton. The run may have to be performed in the morning or at lunchtime and the shadow badminton in the evening.

The following programme is simply an example of the sort of work that might be attempted by an international and it would be expected that the player would organize his day to complete his training work in conjunc-tion with his on-court skill practice.

Pre-season (August/September)	
Aim: To develop the oxygen system, flexibility, strength, power, and agility	
Number of days per week:	6 days
Time available each day:	1½ hours
Training routines:	
Days 1 and 3	
Warm-up and flexibility	10 minutes
Quality *Fartlek* run.	30 minutes
Warm-down	5 minutes
Shadow badminton. 4 x 3 minutes with 3-minute rest interval	24 minutes
General circuit	10 minutes
Days 2 and 4	
Warm-up and flexibility	10 minutes
Shadow badminton. 6 x 5 minutes with 2½-minute rest interval	45 minutes
Fartlek run.	15 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes

Days 5 and 6	
Warm-up and flexibility	10 minutes
Quality run. 6 x 5 minutes with 2½-minute rest interval	45 minutes
Shadow badminton. 4 x 3 minutes with 3-minute rest interval	24 minutes
General circuit	10 minutes
Early season (October/November)	
Aim: To maintain the oxygen system and develop the lactic acid system	
To maintain flexibility and agility and improve strength and power and increase speed	
Number of days per week:	4 days
Time available each day:	1½ hours
Training routines:	
Days 1 and 3	
Warm-up and flexibility	5 minutes
Quality *Fartlek* run.	30 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes
Shadow badminton. 4 x 2 minutes with 4-minute rest interval	24 minutes
General circuit	5 minutes
Days 2 and 4	
Warm-up and flexibility	10 minutes
Shadow badminton or continuous rallying 4 x 2 minutes with 4-minute rest interval	24 minutes
Skipping. 5 x 3 minutes with 2-minute rest interval	25 minutes
General circuit	10 minutes
Mid-season (December/January)	
Aim: To develop the lactic acid system and the ATP-PC system	
To maintain the other fitness components	
Number of days per week:	4 days
Time available each day:	1½ hours
Training routines:	
Days 1 and 3	
Warm-up and flexibility	10 minutes
Training sequence. 15 x 1 minute with 3-minute rest interval	60 minutes

General circuit	15 minutes
Days 2 and 4	
Warm-up and flexibility	10 minutes
Quality *Fartlek* run.	15 minutes
Continuous feeding or shadow badminton.	
20 x 30 seconds with 1½-minute rest interval	40 minutes
Skipping. 5 x 1 minute with 30-second rest interval	7½ minutes
General circuit	10 minutes
Late season (February/March)	
Aim: To develop the ATP-PC system	
To maintain the other fitness components	
Number of days per week:	3 or 4
Time available each day:	1½ hours
Training routines:	
Days 1 and 3	
Warm-up and flexibility	15 minutes
Training sequences with or without a feeder. 4 sets of	
10 repetitions of 20 seconds with 1-minute rest interval	54 minutes
Warm-down	5 minutes
General circuit	10 minutes
Days 2 and 4	
Warm-up and flexibility	15 minutes
Training sequences with or without a feeder. 25 x 10	
seconds with 30-second rest interval	17 minutes
Warm-down	5 minutes
Quality *Fartlek* run.	15 minutes
Skipping. 5 x 2 minutes with 1-minute rest interval	15 minutes
General circuit	10 minutes

THE BOOK

Most people, at whatever level they play, want to become better badminton players. Fitness training is one method of improving performance, and this book provides information on training for all players, regardless of their level of skill. Most important, *Get Fit for Badminton* will help the player to select the type of training programme best suited to his needs. The player who `trains' regularly by running and doing flexibility exercises, judging his fitness by how he feels and looks, will find that this approach is only satisfactory up to a point; it does not guarantee that the most efficient training methods and means of evaluating them are being used. This book, written by two specialists in physical education, one a top coach in the sport and the other a leading sports scientist, encourages both player and coach to design training programmes based upon sound scientific principles which will provide a framework for any form of training they wish to adopt and will enable them to make an accurate assessment of its value.

Note: *Since 1980 when the book was first published there have been many developments in fitness training some of which are included in Excelling at Badminton. However this book provides a basic introduction to the fitness demands of badminton and how to get fit for badminton.*

THE AUTHORS *(in 1980 when book first published*)

JAKE DOWNEY is a Senior Lecturer in the departments of Physical Education and Dance at the Hertfordshire College of Higher Education, and is at present completing an M.Phil. degree in the philosophy of education at London University. He has a wide playing experience of most games but in recent years has concentrated on badminton in which he is an international coach. He has coached many of England's top players, including Paul Whetnall, Ray Stevens, Margaret Lockwood and Gillian Gilks, as well as the Uber Cup team of 1972-5-

Jake has just written and presented a series of programmes on badminton for the BBC and is well known as a writer on the game. He has published two other books in this field with Pelham Books, *Better Badminton for All* and *Badminton for Schools,* and is a regular contributor to journals.

DAVID BRODIE has taught at Abingdon School, Berkshire, and St Peter's College, Saltley, Birmingham, and is currently a Senior Lecturer at the Carnegie School of Physical Education and Human Movement Studies, Leeds Polytechnic. His previous post was that of Senior Research Fellow at the Carnegie School, where he worked on a variety of research projects involving schoolchildren and international sportsmen and sports-women. This work included the physiological screening of England badminton international Ray Stevens, a project which revealed the need for this book.
David's current research interests are sports science technology, paediatric work physiology and resource materials for the teaching of fitness in schools.
He is married and has two children aged six and three.

Glossary of Terms

ATP This is an abbreviation for adenosine triphosphate. It is a high -energy phosphate compound. It is the means by which chemical energy is carried in the cells.

ATPPC *system* This is an abbreviation for the adenosine tri-phosphate-phosphocreatine system, which is a method of supplying energy rapidly from a chemical substance (phosphocreatine) stored in the cells.

British Association of Sport and Medicine This is a society of doctors, applied physiologists and physical educationists who hold regular meetings and publish a journal in matters concerning sports medicine.

Cardiorespiratory Reference to the heart and lungs.

Cardiovascular Reference to the heart and circulatory system.

Carotid pulse The pulse found in the carotid artery which is located in the side of the neck, either side of the Adam's apple.

Heart rate The number of times the heart beats in 1 minute. An *average* resting heart rate for the general population is 72 beats per minute, but it is quite *normal* to have a heart rate different from this figure. A fit person would be expected to have a lower heart rate. Figures as low as 35 beats per minute have been recorded on highly trained sportsmen.

Kilocalorie Often shortened to Calorie - the capital C denoting 1,000 calories. This is a unit of energy and can refer to energy taken in such as calories in foods, or energy given out such as that expended in physical exercise.

Knocking up The practice of warming up by hitting the shuttle contin-uously between two players prior to a game.

Lactic acid A waste product formed when energy is released during exercise and insufficient oxygen is available at the working muscles.

Phosphocreatine Often called creatine phosphate. A phosphate compound which has high energy stores. The break-down and building-up of this

chemical is involved in the supplying of energy for muscular contraction.

Physiological Reference to internal bodily changes. The science of living things, but in this book specific to human beings.

Training effect The changes brought about as a result of training.

Additional Reading

Basic

Hockey, R.V., *Physical Fitness - the pathway to healthful living,* the C.V. Mosby Company (St Louis, 1977).
Cooper, K.H., *The New Aerobics,* Bantam Books (London, 1970).
Cooper, K.H. and M., *Aerobics for Women,* Bantam Books (London, 1972).

Intermediate

Mathews, D.K., and Fox, E. L., *The Physiological basis of Physical Education and Athletics,* W.B. Saunders Company (Philadelphia, 1976).
deVries, H.A., *Physiology of Exercise for Physical Education and Athletics,* Staples Press (London, 1967).

Advanced

Astrand, I., and Rodahl, K., *Textbook of work physiology,* McGraw-Hill (New York, 1970).

APPENDIX 1

Calculation of Arm-strength Index

$$(\text{Pull-ups} + \text{dips}) \times \left(\frac{\text{weight}}{10} + \text{height} - 60\right)$$

Example

A player weighing 160 lbs and 71 inches tall scores 8 pull-ups and 30 dips.

$$(8 + 30) \times \left(\frac{160}{10} + 71 - 60\right)$$

$$= 38 \times 27$$

$$= 1026$$

The player's arm-strength index is therefore 1026.

APPENDIX 2

Facts and Fancies regarding Food and Energy Expenditures*

1 Do honey, glucose, or other `quick energy' foods eaten before events of short duration enhance performance?

Fact The extra energy needed for short-term performance is already avail-able within the body. Sweets eaten *just* before short-term events will not necessarily improve performance but will be used by the body to help replace the energy used during performance.

2 Is protein a primary source of muscular energy?

Fact In a well-nourished person, protein is not a major source of energy. Protein needs are governed by growth and the increased muscle-mass developed through training.

3 Should candy, sweets, pastries, and cakes be avoided during training, and bread and potatoes restricted?

Fact In sports where extra energy is needed, it is necessary to eat some foods of high starch and sugar content to help keep body carbohydrate reserves filled. It would be hard to meet a requirement over 3,000 calories a day with extra sugars and starches, particularly if the amount of fat was limited.

4 Is it true that no fats, fried foods or oily dressing should be eaten?

Fact During regular training the human body needs a certain amount of fat. Fats in the diet are carriers of the fat-soluble vitamins E, K, D and A. Fat also provides a concentrated form of calories. Furthermore, fat makes a meal more satisfying. Food is tastier and a person does not feel hungry as quickly if meals contain some fat. On entering the intestinal tract; fat causes the release of a hormone, enterogastrone, which slows down the emptying time of the stomach. (A circumstance where the `faster than usual' emptying time of the stomach may be an important factor is the pre-event meal, when fat should be limited.)

**Research Papers in Physical Education vol 3,* no. *3,* 1977. Compiled by S. Matheson, Director of Nutritional Services for the Province of New Brunswick, Canada.

Whether the fat is butter or margarine, the natural fat content of food, the oil in salad dressings or the fat used for frying, almost all are complete-ly digested at about the same rate. Foods fried in fat which has not been burned or which does not contain other contaminants are well tolerated by the normal young person. Therefore, moderate amounts of foods properly fried are not taboo.

5 Are protein and amino-acid supplements needed for muscle-building?

Fact The quality protein provided by such foods as meat, fish, poultry, milk, cheese, and eggs is the best source of tissue-building material. Adverse nutritional effects have been reported in animals when the diet is supple-mented with a single amino acid, an unbalanced mixture of amino acids or a protein of poor nutritional quality. Such supplementation in man is expensive and at best probably useless.

6 Is steak the best source of protein for athletes?

Fact Steak is a good source of protein and so are fish and poultry. Pork and lamb are just as good sources of protein as beef and may be included in the weekly menus. Any meat or meat equivalent that a person enjoys, such as meat-balls, pork, fish, lamb, chicken, hamburger, cheese and eggs, is a good source of quality protein.

7 Does milk `curdle' in the stomach, causing sour stomach and interfer-ing with performance?

Fact When milk is mixed with stomach acids, the curdling that results is a necessary process of digestion and does not cause stomach upset. Milk may buffer excess acid in the stomach (neutraliser of acid).

8 Should one avoid `irritating' foods such as spices and `bulky' foods such as lettuce and bran, and eat only `bland' and 'non-irritating' foods?

Fact Ideas about which foods are `bland' and which foods are `irritating' are usually based on unverified impressions and traditional lore. The few reliable studies that exist fail to substantiate various popular beliefs concerning the effects of food on digestion. Most discomfort or difficulties caused by various foods most likely exist only on an individual basis. Modification of the foods eaten should be based on the previous exper-iences which an individual person may have had.
While white and black pepper, chilli pepper, cloves and mustard seed may be considered `irritating', there seems to be no reason for limiting the use of other spices and herbs, such as paprika, cinnamon, allspice, mace, thyme, and sage.
Lettuce, often considered the symbol of vegetables containing roughage,

actually contains only 1.5-4.5 per cent of indigestible fibre. Lettuce and other vegetables and fruits of even higher roughage (fibre) content do not upset the process of digestion; it is their contribution to faecal bulk which can be of concern.

Index