Computer supported system for the evaluation of fitness of Slovenian youth table tennis players

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Abstract The aim of this paper is to describe the possibility of using computer software for the evaluation of fitness of Slovenian junior table tennis players. A SMMS (Sport Measurement Management System) has been used to determine the optimal morphological and motor condition for table tennis players. In our case, The 36 best male and female junior players in Slovenia were submitted to several morphological and motor tests. By means of different measurements, we can observe the condition of the player. We also discuss the importance of the test in determining the level of a player's predispositions (talent) for table tennis and in evaluating the readiness of a sportsman or of the effectiveness of his training. In the second part of the paper there is an overall presentation of the SMMS program, the hardware and software requirements for its use, its database and a number of presentations and reports on its applications in table tennis.
If we compare the data with the juniors in other racket sports, we can see that there is considerable potential in the motor status of Slovenian table tennis players. Especially important are the longitudinal data on this status and evaluation of the results gained in a longer period of time. This information is necessary for good planning of the training process and its connection with the morphological status of a player.
With the SMMS program, table tennis coaches can regularly follow the results of morphological and motor measurements on the one hand, while on the other hand they can obtain an analysis of the results and an evaluation based on different models (Z-value and ND-models).
(*Key words: table tennis, computer*)

1 Introduction

Performance in table tennis as in any sporting event is the result of a number of factors, which include the amount and structure of training performed, the body's predisposition and adaptation to the training, motivation level, facilities, social-cultural background etc. Therefore, physiological parameters account for only a portion of any performance, and so the role of any exercise physiologist is also similarly limited. Through fitness testing, the factors involving physiological processes, over which there is some control, can be measured and ultimately

improved upon. Competition is the ultimate test of performance capability, and is therefore the best indication of training success. Nevertheless, when trying to maximise performance, it is important to determine the player's ability in various aspects of performance. Fitness testing attempts to measure these components, with the ultimate aim of studying and maximizing the player's ability in each one.

Hundreds of standard fitness tests are used, and many more variations of these. They can range from elaborate and expensive laboratory tests to simple and inexpensive field tests. Each has many advantages and disadvantages that can ultimately determine which is the most appropriate test to perform. If you are designing your own fitness-testing regime, with the information about the relative merits and requirements of each test, you can make an informed choice of the most appropriate test or tests to use.

The benefits of fitness testing in table tennis are necessarily for the exact planning of training. First of all we can identify and establish weaknesses and strengths of the player. This can be done by comparing hid test results to those of other athletes in the same training group or a similar population group. Previous test results of large groups are often published as normative tables. In the small nations there is a problem how to assure enough subjects to make standards, which are declared as norms for population. By comparing results to successful table tennis players, we can see the areas that need improvement, and the training programme can be modified accordingly. On base of the information you can get through fitness testing valuable training time can be used more efficiently. The initial testing session can give the athlete information on his fitness levels at the start of the programme, so that future test result can be compared to this and any changes can be noted. This information is especially important for current adaptation of the contents and loads during training. By repeating tests at regular intervals, we can get an idea of the effectiveness of the training programme.

Fitness testing is primarily used for help in designing the most appropriate athletic training programme for achieving of better results in the table tennis game. A general non-sport specific testing battery can provide a participant with an idea of his basic strengths and weaknesses and from this he may find that he would be better suited to another sport that makes better use of his strengths. Sometimes testing has been used in this way for talent detection. Due to many factors influencing sport performance it has generally low or unknown validity in predicting the future success of juniors.

The Sport Measurement Management System was developed, first, to explain on basis of question why we should perform fitness testing and the benefits of testing, then how to select appropriate fitness tests and how to interpret the results.

2 Methods

The participants were The 36 best male and female junior players in Slovenia. The sample of variables consisted of 28 anthropometric measures and 17 motor tests. Data were processed by the statistical software SPSS 8.0 for Windows and the new software SMMS.

2.1 Program SMMS

The organization and execution of tests is often a time-consuming, strenuous and expensive job for both the athletes and the measurers, the coaches, and other experts involved. In carrying out this work, a special problem is presented by the processing of the test data, including their collection, storing, analysis, and presentation. All these phases of processing can be computer supported. To this end, a number of programs intended specifically for testing athletes, children and youth, participants in various programs as well as other population groups have already been developed in the world and in Slovenia. However, for the majority of them their applicability is very limited as they are often connected with a particular target group only (e.g. pupils in primary schools, athletes in a particular branch of sport, etc.); they do not allow the selection of new tests and other methods for their evaluation; they have limited possibilities as regards the presentation of the results, etc. In developing the program, special attention was paid to the following requirements:

- the program must support all the most frequent operations associated with test data processing;
- the program must allow the processing of data of all population groups, irrespective of gender, age, branch of sport, type of pursuit (recreational, competition or top-level sport), etc.;
- the program must allow the inclusion of arbitrary tests, their conversion into arbitrary indices, and their arbitrary combining into test batteries;
- the program must, within the framework of evaluation models it incorporates, allow arbitrary evaluation of the obtained test results in accordance with the needs of the group is being evaluated;
- the program must enable import and export of all kinds of data in generally known layouts (formats).

Hence, the program has been laid out not only as the so-called production tool intended for end-users (e.g. teachers, coaches etc.) but also as a developmental tool allowing the laboratories, researchers and more progressive coaches who wish to carry out their own modifications of and supplements to the testing system. The products they thus develop; i.e., especially tests, test batteries and evaluation models, are not part of the program itself, yet the program allows their exchange between the developers or development institutions and end users (coaches, teachers). The program thus encourages the creation of new knowledge or products and their exchange and application.

2.1.1 Database: All data needed for the work with the program are stored in a database. The structure of the data is relational, which means that the data are presented by means of mutually related tables (Figure1). In addition to the data on the athletes and the results attained by them on the tests, the database also stores the data (parameters) on the models intended for the evaluation of the obtained results. The data form is Paradox. The database is physically represented by a multitude of files stored in a separate folder, which serves to facilitate their transfer to another computer or making of a back-up copy. The data are easily accessible on an individual computer; by means of suitable adjustments they are also accessible from several computers in a local area network, which have been

given the access right.

When installing the program, some tables (e.g., branch of sport and gender) already contain input data, while others are empty. The user himself takes care of the filling in of the tables manually or by import from external files. An example of the latter is, for instance, the import of tests and models; here, the user can import only those data which are of interest for his branch of sport, age group of athletes he coaches, etc. On the other hand, the user who has prepared some data by himself (e.g. a new test or a new test battery), can - most easily simply over the Internet -offer them to other users.

For editing of the data, the SMMS program has several windows or forms available. The basic form is the form Test results (Figure 2) into which the basic data on the measurement (date, team, etc.), athletes (name, birth date, and similar), and the results attained by them on the tests are entered. In addition to the results of measurements we can also use indices (e.g. the proportion of fat in the body), which the program calculates on the basis of the formulae stored in its database. The data of this kind can also be imported into or exported from the database. In addition to the formats usually applied in carrying out measurements on top-level athletes at the Faculty of Sport, widely used formats, such as DBF (which can, for example, be created in Excel) or SPPS (one of the most widespread statistical packages), can also be applied. The data on the tests (including their descriptions, sketches, etc.) are ordered, and their assembly into groups is carried out on the form Tests/batteries.

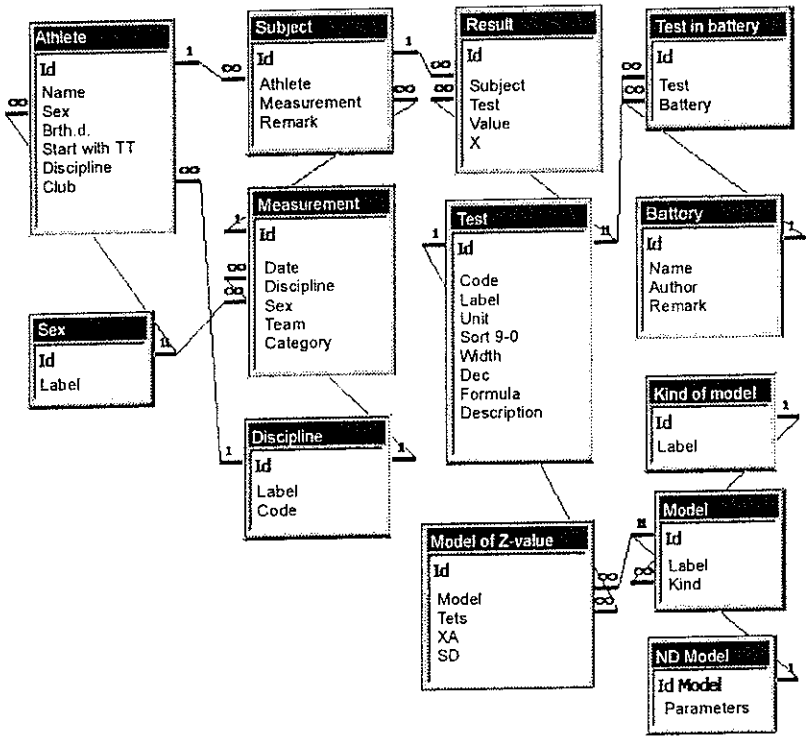

Figure 1. Data model

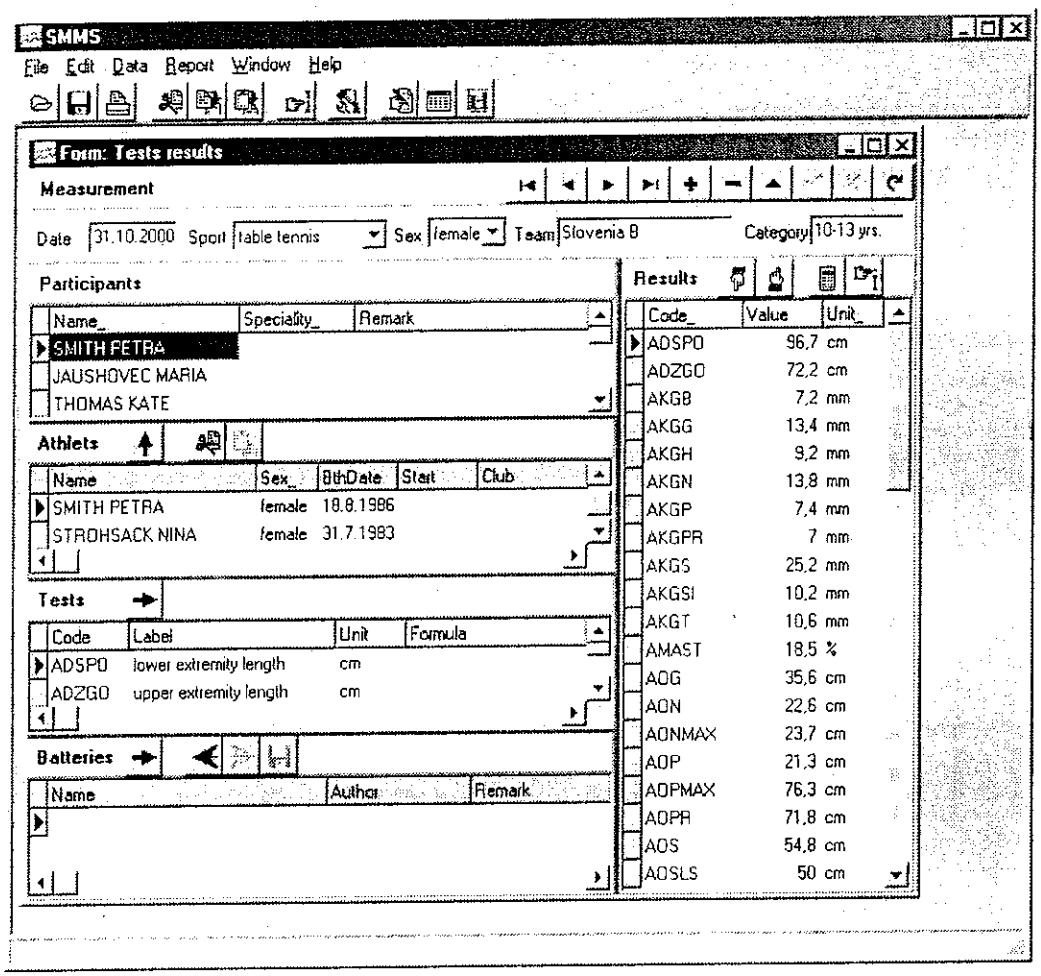

Figure 2. Window of the SMMS program with the test results form.

2.1.2 Models for the evaluation of test results: In addition to the data on athletes and the results of the tests performed on them, the database also scores models by which the results can be evaluated. The SMMS program supports two kinds of models: z-value models and ND models. The former are used for making the so-called profiles which show for each test how much the athlete deviates from the model (in the positive or in the negative direction). ND models allow the attained results to be divided into quality categories (e.g., into a 5-level "school" scale from unsatisfactory to excellent, while the user can arbitrarily select the number of levels and their denomination). Qualified experts or institutions usually design the models; however, the user can also design them by himself, or he can supplement or modify the existing ones. For this purpose a form for ordering for every type of the model (Figure 3) is available to him.

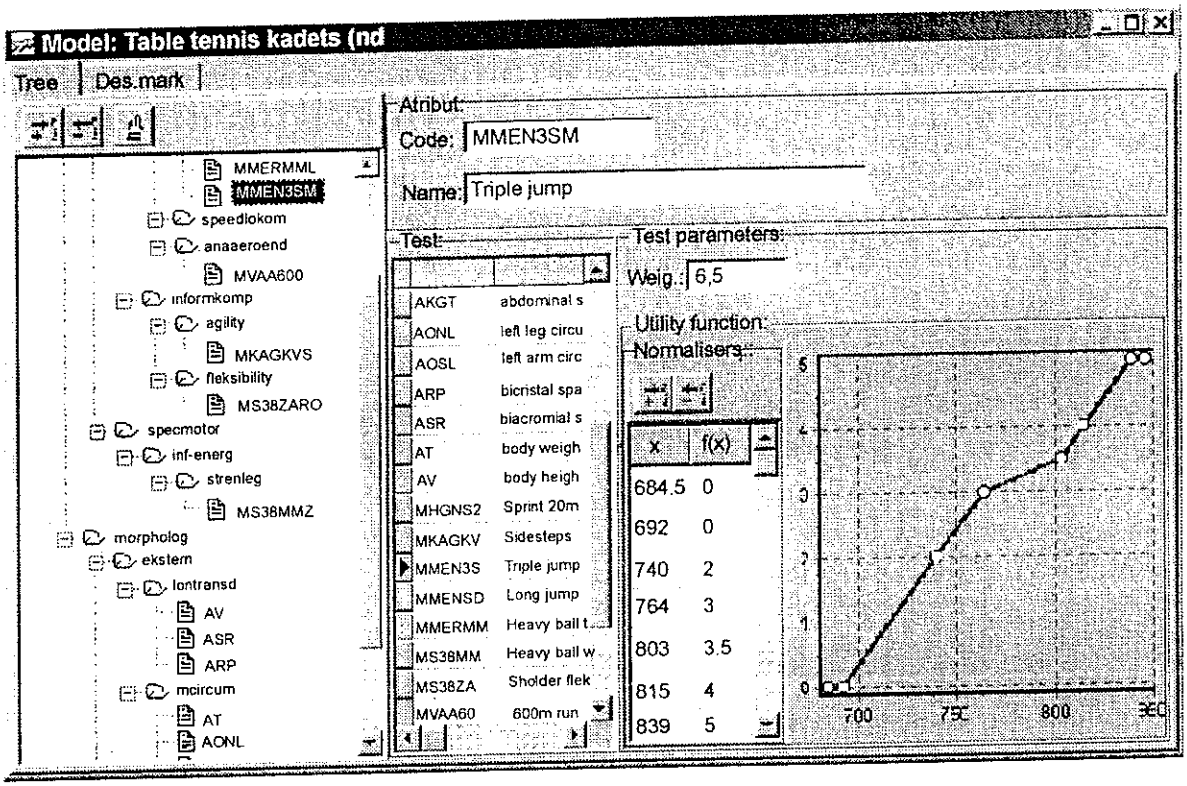

Figure 3. Form for editing of the ND models.

Table 1. Motor results by SPSS.

Cadets

GROUP	1		2		3	
	Mean	SD	Mean	SD	Mean	SD
MSARG	55.3	5.06	47.9	6.04	33.3	5.71
M4SKOK	1015	28.87	935	66.4	744.3	58.55
MTRSK	725	23.45	647.1	35.57	520	46.55
MT20	3.1	0.03	3.4	0.13	3.8	0.1
MST	11	1.08	9.3	1.47	7.1	1.28
MT5REA	1.1	0.04	1.2	0.09	1.3	0.04
MSDM	243.8	3.86	216.9	12.52	181.6	16.04
MDT60	59	6.06	50.7	2.36	41.6	5.03
MTAPNO	35.8	0.5	30.9	2.48	28.1	1.07
MTAPRO	53.3	2.89	50.1	3.39	40.2	5.34
MTPK	52.5	4.04	51	7.85	44.9	2.27
MZVIN	75.8	7.32	76.6	15.81	66.7	6.31
MIZPK	177.5	12.56	177.7	15.03	159.3	10.13
MZON	26	2	24.1	3.85	19.8	4.44
MKVS	8.1	0.61	8.1	0.28	9.5	0.82
MTSS	9.7	0.5	10.5	0.65	11.4	0.49
MTAG	10	0.52	10.3	0.57	11.7	0.8

Juniors

GROUP	1		2		3	
	Mean	SD	Mean	SD	Mean	SD
MSARG	39.2	4.17	35.8	7.01	28	4.69
M4SKOK	815.8	40.55	781.9	76.48	712.5	40.52
MTRSK	586.7	33.71	568.1	49.92	523.8	29.26
MT20	3.7	0.17	3.8	0.21	4	0.18
MST	6.2	0.93	7.1	1.12	6.9	2.06
MT5REA	1.3	0.06	1.3	0.09	1.3	0.11
MSDM	192.2	17.54	184.9	18.78	174.5	6.35
MDT60	47.2	3.82	46.9	6.45	43	11.17
MTAPNO	31.2	1.17	29.4	2.45	26	2.16
MTAPRO	50	3.79	45.5	3.21	37.5	7.05
MTPK	53.8	2.56	53.1	3.27	46	3.74
MZVIN	62.3	4.89	55.5	8.96	65.8	7.93
MIZPK	167.7	8.5	169.4	11.76	155.8	7.59
MZON	23.8	2.32	20.8	3.33	14	2.45
MKVS	9.7	0.56	9.3	0.39	10.7	0.97
MTSS	11.4	0.47	11.4	0.43	12.3	0.46
MTAG	11.8	0.4	11.7	0.53	12.2	0.51

2.1.3 Presentation of test results: In addition to the forms already mentioned in the section on database, the results of testing can also be shown in the form of tables and charts. The latter form is particularly illustrative and permits three presentation units: measurement, athlete, and test subject. The presentation of a measurement (Figure 4) shows the results of all athletes for an individual (arbitrarily selected) test; the presentation of an athlete shows all results of an individual athlete and individual test for all measurements he or she participated in so far, while presentation of a test subject shows at the same time the results of an athlete for several arbitrarily selected tests and measurements.

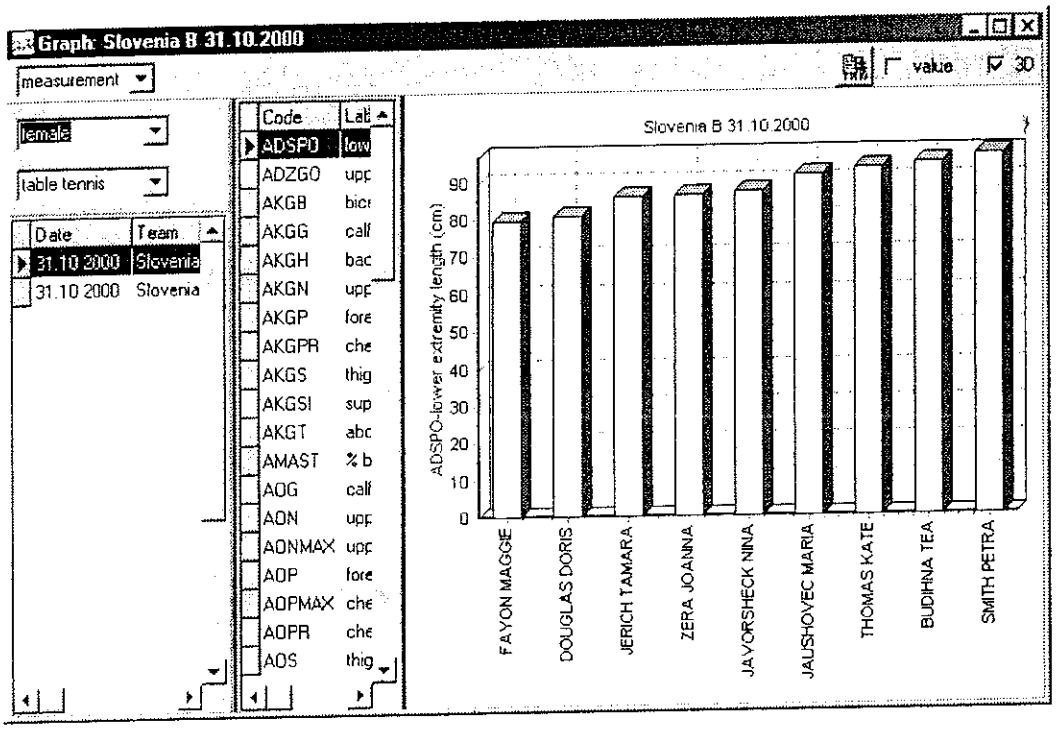

Figure 4. Presentation of the results in form of a chart.

2.1.4 Reports: If tables and charts are primarily intended to present the results of testing on a screen, then the reports made by the SMMS program are usually printed out or sent in some other way (e.g. by e-mail) to the end users (coaches, athletes etc.). The program allows the designing of several kinds of report: the report Title page shows the basic data on the measurement and athletes taking part in it. The report Order by tests shows - for an individual test or for all tests performed in connection with the measurement selected - for all participants in the tests, the last result achieved by them and all previous results for the period selected. The reports Profile of a test subject (Figure 5) and ND (Figure 6) show the results of data processing by z-value models and ND models, respectively. A special kind of report is the Record sheet, which for an arbitrarily selected test battery displays a form into which the results of testing are entered.

The SMMS program makes all reports simply in the MS Word program where they can be viewed, printed out, sent by fax or e-mail, and if necessary they can also be additionally ordered, provided with opinions, instructions for training, etc.

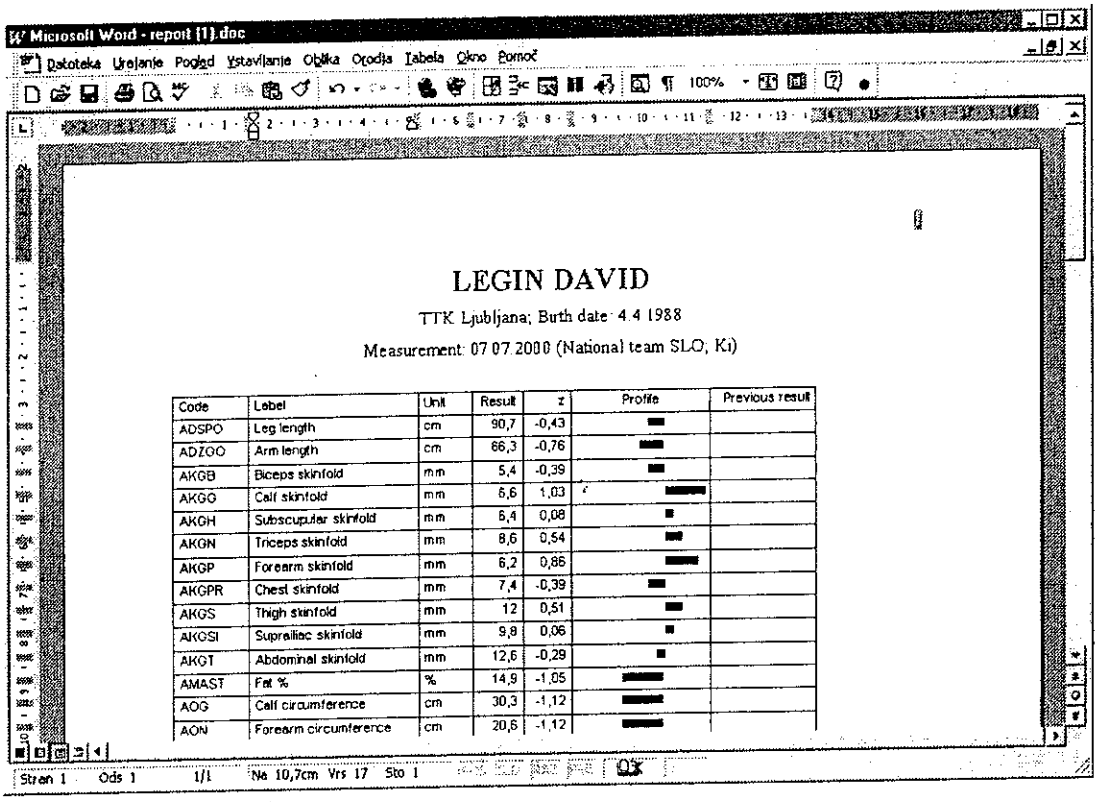

Figure 5. Profile report (opened in MS Word).

		VDIMAR GREGOR			JAZBEC ZIGA			KOSCAK JURE			VODUSEK DAMIJ			OCEPEK TOMI		
Code	Unit	Res.	f(x)	Mark	Res.	f(x)	Mark	Res.	f(x)	Mark	Res.	f(x)	Mark	Res.	f(x)	Mark
OCENA			3,5	v. good		3,4	good		3,2	good		3,2	good		3,1	good
motorio			3,5	good		3,6	v.good		3,4	good		3,4	good		2,9	accep.
basicmotoric			3,4	good		3,6	v.good		3,3	good		3,3	good		2,6	accep.
aeroomp			4,1	exc.		3,6	v.good		3,3	good		3,3	good		2,9	accep.
faststreng			4,3	exc.		3,3	good		3,0	good		2,7	accep.		2,8	accep.
MMENSDM	cm				255	3,3	good	255	3,3	good	270	4,5	exc.	245	2,7	accep.
MMERMML	pon.	235	4,3	exc.	300			225	3,4	good	190	1,0	unacc.	240	5,0	exc.
MMEN3SM	cm				795	3,4	good	750	2,4	accep.	760	2,8	accep.	700	0,3	unacc.
fastlokom			4,2	exc.		4,4	exc.		4,2	exc.		4,6	exc.		3,4	good
MHGNS20L	s	3,02	4,2	exc.	2,96	4,4	exc.	3,03	4,2	exc.	2,92	4,6	exc.	3,22	3,4	good
anaerobend			3,3	good		3,3	good		2,8	accep.		3,1	good		2,6	accep.
MVAA600	s	115	3,3	good	115	3,3	good	123	2,8	accep.	118	3,1	good	125	2,6	accep.
inforoomp			0,6	unacc.		3,4	good		3,2	good		3,1	good		1,2	unacc.
agility						3,8	v.good		3,3	good		3,2	good		1,2	unacc.
MKAGKVS	s				7,15	3,8	v.good	7,46	3,3	good	7,5	3,2	good	8,06	1,2	unacc.
flexibility			0,6	unacc.		2,0	accep.		2,7	accep.		2,7	accep.			
MS38ZARO	cm	60	0,6	unacc.	70	2,0	accep.	75	2,7	accep.	75	2,7	accep.	50		
specmotor			3,7	v. good					3,8	v.good		3,8	v.good		4,0	exc.
inf-energ			3,7	v. good					3,8	v.good		3,8	v.good		4,0	exc.
strenttle			3,7	v. good					3,8	v.good		3,8	v.good		4,0	exc.
MS38MMZ	cm	300	3,7	v. good	380			310	3,8	v.good	305	3,8	v.good	320	4,0	exc.
morpholog			3,4	good		3,2	good		2,9	accep.		3,0	accep.		3,4	good
eksternedi			3,4	good		3,2	good		2,9	accep.		2,9	accep.		3,4	good
longitudi			3,5	good		3,4	good		3,0	good		2,8	accep.		3,5	v.good
AV	cm	175,2			189,2	3,2	good	175,8			189	3,1	good	194	4,0	exc.
ASR	cm	43,5	3,5	v. good	44,1	3,7	v.good	42,1	3,0	good	40	1,7	unacc.	42,6	3,2	good
ARP	mm	217			249	4,1	exc.	222			236	2,8	accep.	231	1,5	unacc.
circum			3,0	accep.		2,5	accep.		2,3	accep.		3,0	good		3,1	good
AT	kg	74,3	1,6	unacc.	75,6	1,8	unacc.	70,3	1,0	unacc.	79,2	2,3	accep.	85	3,3	good
AONL	mm	317	3,8	v. good	296	3,3	good	298	3,3	good	303	3,4	good	282	3,0	good
AOSL	mm	585	3,3	good	542	2,1	accep.	550	2,3	accep.	589	3,3	good	577	3,1	good
interadi			3,7	v. good		4,4	exc.		4,4	exc.		4,0	exc.		3,5	v.good
skinfold			3,7	v. good		4,4	exc.		4,4	exc.		4,0	exc.		3,5	v.good
AKGT	mm	12	3,3	good	7,8	4,2	exc.	6,2	5,0	exc.	10	3,4	good	19	2,2	accep.
AKGS	mm	12	4,0	exc.	7,8	4,6	exc.	11,8	4,0	exc.	9	4,4	exc.	9,4	4,3	exc.

Figure 6. ND report.

2.2 The possibilities of SMMS application in table tennis

At the Faculty of Sport we have managed, in the past, to define the motor and morphological model of table tennis players in the various age categories for both genders by means of research work and empirical knowledge of table tennis. For this purpose we selected and adapted a suitable group of tests, and prepared norm values and software by means of which the results of tests can be processed and presented in a suitable manner. On the basis of this acquired knowledge we could start some years ago with the measurements of motor abilities and morphological characteristics using a test battery of an optimal size, which allows a relatively rapid and easy execution of the measurements on a larger number of test subjects. The results, which have been suitably processed and presented, give a basic (though rough, yet for the needs of practice thoroughly satisfactory,) insight into the state of the morphological characteristics and motor abilities of an individual. Here we think, of course, of those morphological characteristics and motor abilities, which are of a particular importance for successful playing performance in table tennis. The mentioned measurements are carried out with the objective that the data acquired would help the coaches in their decisions concerning the selection as well as in planning and executing the training sessions.

In addition it is also necessary to mention that the norm values are set from the aspect of the achievement of top-level results and caution is necessary when using them for the needs of clubs. Conditionally, the above-mentioned results can also be used for checking the training status. The program will also be gradually upgraded with other processing possibilities. It is, as already mentioned; also open to setting up specific test batteries and evaluation models by individual coaches.

3 Conclusions

In the end it is worth mentioning that for successful playing of table tennis, other abilities, characteristics and properties of a child, as well as also the circumstances in which an individual club works are also important. Excluding the children from a group solely on the basis of poor results on motor and morphological tests can be more harmful than useful. On the basis of knowledge of the child's abilities the coach must, of course, be aware of the child's limitations as regards the possibility of achievement of the top-level results and must not encourage false hopes or even give the child a role which he or she cannot justify in front of himself or herself and in front of others. The situation is different in national teams, where the criteria of selection must be objectified and fair - here the evaluation of the motor and morphological model of a player can make the coach's work considerably easier.

The software, which allows the coach to monitor more easily, the effects of transformation processes is more than welcome. Of particularly great value is the SMMS program which allows the user a continuous adaptation to the current circumstances, at the same time also allowing him the creation of new models or setting up of new test batteries or measurement procedures. If you don't know

what the numbers in the results mean, the tests are fairly useless. The results must have meaning so that they can be applied to modify a training programme. This information is especially important for current adaptation of the contents and loads in the process of training.

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