

Sindik Joško*, Juričević Marko**

**Kindergarten Trnoruzica, Zagreb, Croatia*

***X. Gymnasium, Zagreb, Croatia*

DEPENDENCE OF RESULTS IN TABLE TENNIS ON CERTAIN GAME EFFICIENCY INDEXES

Abstract

From sports aspect, the basic and most utilitarian indicator of game quality is exactly the achieved result on a particular sports competition. Amongst different manners of quality analysis of table tennis players' game, the basic idea of research was to seek to detect those indicators (data) for collection of which only the final result in particular competitions in larger number of events, in one table tennis match, certain sets in one table tennis match could be sufficient. Sindik (in year 1999) performed that by implementation of variables which could directly be derived from the results of competitions, however, those variables one could reduce to a smaller number of indexes. The basic aim of the research is to question to which extent the indexes directly derived from the results of individual table tennis matches could foresee indexes which are described by the final result of an individual in a larger number of individual table tennis matches. Research is comprised of analysis of appropriate sample of 39 entities – *total individual competition effect of sportsmen in 9 team championships*, for all the players of one table tennis team, in the period from 1990 till 1996, in the organization of TTOCAZ, in different competition ranks in which the named team has competed. 16 indexes – indicators of efficiency of an individual in table tennis competition have been defined, which can be derived directly from the competition results. The predictive value of used indicators has been determined, significant in statistical manner, for the prognosis of direct indicators of success on basis of other indexes. However, due to characteristics of the sample, the generalization of results is not possible.

Key words: *table tennis, game efficiency, correlation, basic hypotheses, data collection, entities, dependent variables, independent variables, collective indexes, multiple regression analysis*

INTRODUCTION, GOAL AND HYPOTHESIS

Except in technical field, table tennis is demanding, as well with regards to tactful knowledge and appropriate conative characteristics necessary for a successful competition achievement (Grujić, 1975, Hudetz, 1982).

The basic question which is set by the professionals aiming to improve result effect of sportsmen or teams in different sports is – how to assess the game quality (Brčić, Viskičić-Štalec, Fressl, 1997). From sports aspect, the basic and most utilitarian indicator of game quality is exactly the achieved **result** on a particular sports competition. Amongst different manners of quality analysis of the table tennis players' game, the basic idea of research was to seek to detect those indicators (data) for collection of which only the final result in particular competitions in larger number of events, in one table tennis match, certain sets in one table tennis match could be sufficient. Sindik (in year 1999) performed that by implementation of variables which could directly be derived from the results of competitions, however, those variables one could reduce to a smaller number of indexes.

The **basic aim** of the research is to question to which extent the indexes directly derived from the results of individual table tennis matches could foresee indexes which are described by the final result of an individual in a larger number of individual table

tennis matches. This kind of analysis could potentially be useful, as well for the needs of future programming of scholastic process for individual player. **Particular goals** are to determine:

1. basic descriptive characteristics and correlation between particular indexes – indicators of table tennis game efficiency;
2. ability of index prognosis: NUMBER OF MATCHES WON/LOST, NUMBER OF SETS WON/LOST – on basis of other indexes of table tennis game efficiency;
3. to determine correlation between so called 'collective indexes' of efficiency, derived by summarization of several particular indexes.

Past researches, which could directly be connected with the author's ideas – in table tennis, have not been found in available literature. From the research goals, following **basic hypotheses** have been derived:

- H1: Indicators (indexes) directly derived from the results are not correlated in statistically significant manner.
- H2: Indicators (indexes) directly derived from the results do not predict in statistically significant manner the indexes – indicators of final competition success – indicator NUMBER OF MATCHES WON/LOST, NUMBER OF SETS WON/LOST.
- H3: So called 'collective indexes' derived from particular indexes are not correlated in a statistically significant manner.

WORK METHODS, ENTITIES AND VARIABLES

Data collection has been performed by inspecting results of individuals – examinees of the given sample in the minutes of matches played. The total result of an individual in larger number of individual tennis table matches, sets, games has been registered.

Research is comprised of analysis of appropriate sample of 39 **entities** – *total individual competition effect of sportsmen in 9 team championships*, for all the players of one table tennis team 'Patuljci pojma nemaju (*Dwarfs do not have a clue*)', in the period from 1990 till 1996, in the organization of Table Tennis Organization of Clubs and Activities of Zagreb (TTOCAZ) - in different competition ranks in which the named team has competed. The team played all the games visiting, the role of judges and audience was reduced to a minimum, while matches were played in two sets won. Each individual whose result was collected played at least 10 individual matches within a particular competition, while the maximum number of individual matches which the individual could play during one competition was 33. Or in table:

CHAMPIONSHIP	1.	2.	3.	4.	5.	6.	7.	8.	9.	TOTAL
NUMBER OF MATCHES	99	99	99	99	99	99	99	99	99	891
NUMBER OF PLAYERS	4	5	4	4	5	4	5	4	4	39

SAMPLE OF 'VARIABLES'¹

16 indexes – indicators of efficiency of an individual in table tennis competition have been defined, which can be derived directly from the competition results. These indexes are theoretically organized as a 'composition' of two or even three particular variables, while their basic 'logic' is the calculation of ratio between effectively accomplished number of cases and the maximum possible number of cases, in relation to the hypothetic indicators of efficiency in competition situations. Following 'individual' indicators (indexes) have been determined: As **dependent 'variables'**, *indexes which*

¹ (Note: quotations on the word 'variable' indicate to the specific quality of the research; i.e. to the fact that instead of variables indicators / parameters / respectively indexes were used in the analysis, as compositions of two or three variables.)

are direct indicators of players' efficiency (ordinal number 1, 2), i.e. criteria have been determined:

1. WIN/LOSEGAME – ratio between the number of matches won and lost – in individual matches: - number of matches won is divided with the total number of matches played; calculated for each entity by the ratio amount expressed in %;
2. WIN/LOSESET – ratio between the number of sets won and lost – in sets of played matches of an individual: - number of sets won is divided with the total number of sets played; entity is adjoined with the amount expressed in %;

Independent 'variables' were predictors directly derived from the results (ordinal number 3-14):

3. WIN/LOSEDIFF – ratio between the numbers of sets won and lost – in sets played on difference (21:19, 22:20 etc.): - number of sets won on difference is divided with the total number of sets played on difference; entity is adjoined the amount of ratio expressed in %;
4. WIN/LOSE3SET – ratio between the number of matches won and lost – in matches played in 3 sets (namely, when the result is 2:1 – if the matches are played on 2 sets won); number of matches won is divided with the total number of matches played, while the entity is adjoined with the amount of ratio expressed in %;
5. WINLESS11S – ratio between the number of sets won in which the opponent won less than 11 points per set: number of sets won in which the opponent won less than 11 points is divided with the total number of sets played (in championship or on a tournament), while the entity is adjoined the amount of ratio expressed in %;
6. WINLESS11BOTH – ratio between the number of matches won in which the opponent won less than 11 points in both sets (when the match is won with the result 2:0) : number of sets won in which the opponent won less than 11 points is divided with the total number of matches played (in championship); entity is adjoined the amount of ratio expressed in % ;
7. LOSELESS11S – ratio between the number of sets lost in which the opponent won with the result of more than 11 points difference per set: number of sets lost in which the opponent won with more than 11 points difference is divided with the total number of sets played (in championship); entity is adjoined the amount of ratio expressed in % ;
8. LOSELESS11BOTH – ratio between the number of matches lost in which the opponent won with the result of more than 11 points difference in both sets (namely, when the result is 0:2) to the benefit of the opponent : number of matches lost in which the opponent won with the result of more than 11 points difference in both sets is divided with the total number of matches played (in championship); entity is adjoined the amount of ratio expressed in % ;
9. WIN/LOSE1SLOST – ratio between the number of matches won and lost – in which an individual lost first set; number of matches won in which an individual lost first set (namely, when the result is 2:1 to the benefit of an individual) is divided with the total number of matches played in which an individual lost first set (in total, regardless of winning or losing); entity is adjoined the amount of ratio expressed in % ;
10. WIN/LOSE2SLOST - ratio between the number of matches won and lost – in which an individual lost second set; number of matches won in which an individual lost second set (namely, when the result is 2:1 to the benefit of an individual) is divided with the total number of matches played in which an individual lost second set (in total, regardless of winning or losing); entity is adjoined the amount of ratio expressed in %
11. WIN/LOSEW1L2S - ratio between the number of matches won and lost – in which an individual won the first and lost second set; number of matches won in which an individual won the first and lost second set (namely, when the result is 2:1 to the benefit of an individual) is divided with the total number of matches played in which an individual won the first and lost second set (in total, regardless of winning or losing); entity is adjoined the amount of ratio expressed in %
12. WIN/LOSEW2L1S - ratio between the number of matches won and lost – in which an individual lost the first and won second set; number of matches won in which an

individual lost the first and won second set (namely, when the result is 2:1 to the benefit of an individual) is divided with the total number of matches played in which an individual lost the first and won second set (in total, regardless of winning or losing); entity is adjoined the amount of ratio expressed in %

13. WIN/LOSE1SWON- ratio between the number of matches won and lost – in which an individual won the first set; number of matches won in which an individual won the first set (namely, when the result is 2:1 to the benefit of an individual) is divided with the total number of matches played in which an individual won the first set (in total, regardless of winning or losing); entity is adjoined the amount of ratio expressed in %
14. WIN/LOSE2SWON - ratio between the number of matches won and lost – in which an individual won the second set; number of matches won in which an individual won the second set (namely, when the result is 2:1 to the benefit of an individual) is divided with the total number of matches played in which an individual won the second set (in total, regardless of winning or losing); entity is adjoined the amount of ratio expressed in %
- 15.²NUMBERONDIFF - ratio between the number of played sets on difference – in relation to the total number of sets played on difference; number of sets played on difference is divided with the total number sets played; entity is adjoined the amount of ratio expressed in %
- 16.²NUMBERM3SETS –ratio between the number of matches played in 3 sets – in relation to the total number of matches played; number of matches played in 3 sets is divided with the total number of matches played; entity is adjoined the amount of ratio expressed in %.

So called '**collective indexes**' derived from individual indexes based on principle of 'logical connection':

- I. DIRINDEFF – direct indicator of result efficiency in a competition – represents a sum of percentage values for indexes no. 1 and 2; it has been presumed that the 'collective index' is able to provide an insight to the general result effect of an individual during the competition in the given championship
- II. EQUALIZATION– equalization (incertitude of matches of an individual in given championship competition) – represents a sum of percentage values for indexes no. 15 and 16; it has been presumed that the 'collective index' is able to provide an insight to the result equalization of an individual against sports opponents during the competition in given championship
- III. SECURINCRYSIS – stability in critical situations (in conditions of increased tension, result incertitude) - represents a sum of percentage values for indexes no. 3,4,11 and 12; it has been presumed that the 'collective index' is able to provide an insight to the result efficiency when high amount of result equalization is present with an individual and its sports opponents during the competition in given championship
- IV. MEASURING UP - (to which extent the individual is able to measure up to competition rank in sense of its competition efficiency) - represents a sum of percentage values for indexes no. 5,6,7 and 8; it has been presumed that the 'collective index' is able to provide an insight to the result unequalization of an individual and its sports opponents during the competition in given championship
- V. GENERALSTABIL – general stability (competition efficiency of an individual in more and less result equalized competition situations) - represents a sum of percentage values for indexes no. 9,10,13 and 14; it has been presumed that the 'collective index' is able to provide an insight to the 'structure' of efficiency in a competition when reasonably high amount of result equalization is present with an individual and its sports opponents during the competition in given championship
- VI. TOTAL - (total indicator of efficiency of an individual in championship competition) -

² Indexes o. n. 15 and 16 are only used in descriptive statistics and in correlation analysis, while they are not used as predictors, or as criteria.

represents a sum of percentage values for indexes no. 1-14; it has been presumed that the 'collective index' is able to provide an insight to the total efficiency of an individual in events with sports opponents during the competition in given championship.

METHODS OF RESULT ANALYSIS

Arithmetic mean and variants of samples of all 16 selected indexes have been determined, and correlation and graded multiple regression analysis with backward strategy has been performed (Krković, 1978). Criteria variables founded on the number of victories (no.1, 2) have been projected on the basis of predict-kind variables no. 3-14. All used methods of processing and result overview have been received within the *Microsoft Excel* computer support program. Research restrictions consisted of using the appropriate, not random entity sample (Nikolić, 1998), while the result distributions for all indexes have not been initially normally distributed. Viskić-Štalec (1998) describes a sequence of 'corrective' procedures in different experimental situations. In this research following 'corrective' procedures have been performed: standardization of results for all indexes, transformation into z-values. As well, poor possibility of result generalization is emphasized.

RESULTS, DISCUSSION, CONCLUSIONS

Relevant fault of the efficiency indicators directly derived from the competition results is the fact that the total result does not need to necessarily be the real 'measure' of players' competition efficiency. In practical situations in competition, it might come to players being 'laid-back' in situations of more significant result advantage or 'fall back' in relation to the opponent, 'predictions' of convincing victory or defeat, 'playing' with anticipatory inferior or 'superior' opponent during the entire event. However, in average and in 'result-wise more equalized' competitions, suggested efficiency indicators could be useful hypothetically. Furthermore, one did not consider: different quality levels of different players (in relation to competition effect), different levels of opponents' qualities (Brčić, Viskić-Štalec, Fressl, 1997) – especially considering different levels of competition (leagues).

On basis of analysis of degree of symmetry of the result distribution for particular indexes, in multiple regression analysis extremely aberrant indexes - no. 6, 7,8,14 and 15, are not included. In Table 1 average result values for individual indexes are determined, while the amounts of obtained result variants are direct consequence of potential and actual result range for given indexes (Minimum and Maximum). With regards to inter-correlation of efficiency indexes on the basis of competition results, strong correlation of so called direct indicators of efficiency (o.n. 1, 2) is noticeable. Namely, as a rule indexes are – direct indicators of efficiency NUMBER OF MATCHES/SETS WON (namely, o.n. 1, 2.) medium strongly or strongly connected with other indexes, except those under no. 15 and 16. Equalization' of sports opponents, manifested in index NUMBER OF MATCHES PLAYED ON DIFFERENCE, is poorly connected with the equalization of opponents under NUMBER OF MATCHES PLAYED IN 3 SETS.

In Tables 3 and 4 predictive values of predictive indexes is determined for the prognosis of direct efficiency indicators –o.n. 1. and 2. (NUMBER OF MATCHES/SETS WON/LOST). Both coefficients of multiple regression are significant statistically with $p < 0.01$. For the index *NUMBER OF WON/LOST MATCHES* (Table 1) the most predictive individual index is NUMBER OF WON/LOST MATCHES WHEN SECOND SET WAS LOST, and NUMBER OF WON/LOST MATCHES WHEN FIRST SET WAS WON ($p < 0.01$). For the index *NUMBER OF SETS WON* (Table 2) the most effective prognosis is given by the same indexes.

Table 1. Prognosis of NUMBERS OF WON/LOST MATCHES on basis of other particular variables (standardized results)

<i>Regression Statistics</i>	
Multiple R	0,98
R Square	0,95
Adjusted R Square	0,93
Standard Error	0,27
Examinees	39
Importance	p<0.01

<i>VARIABLE</i>	<i>Beta-coeff.</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>Importance</i>
WIN/LOSEGAME	0,00	0,04	0,00	1,00
NUMBERM3SETS	-0,20	0,07	-2,98	p<0.01
NUMBERONDIFF	-0,03	0,06	-0,48	0,63
WIN/LOSE3SET	-0,16	0,18	-0,90	0,38
WIN/LOSEDIFF	0,20	0,06	3,57	p<0.01
WIN/LOSE1SWON	0,35	0,07	5,02	p<0.01
WIN/LOSE2SWON	0,10	0,09	1,03	0,31
LOSELESS11S	-0,20	0,09	-2,33	0,03
LOSELESS11BOTH	-0,18	0,07	-2,52	0,02
WIN/LOSE1SLOST	0,13	0,10	1,30	0,21
WIN/LOSE2SLOST	0,55	0,10	5,62	p<0.01
WINLESS11S	0,13	0,08	1,70	0,10
WINLESS11BOTH	0,11	0,07	1,66	0,11
WIN/LOSEW1L2S	-0,22	0,12	-1,86	0,08
WIN/LOSEW2L1S	0,16	0,11	1,46	0,16

Table 2 – Prognosis of NUMBERS OF WON/LOST SETS on basis of other particular variables (standardized results)

<i>Regression Statistics</i>	
Multiple R	0,97
R Square	0,94
Adjusted R Square	0,90
Standard Error	0,31
Examinees	39
Importance	p<0.01

<i>VARIABLE</i>	<i>Beta-coeff.</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>Importance</i>
WIN/LOSESET	0,00	0,05	0,00	1,00
NUMBERM3SETS	-0,15	0,08	-1,90	0,07
NUMBERONDIFF	-0,05	0,07	-0,70	0,49
WIN/LOSE3SET	-0,33	0,21	-1,61	0,12
WIN/LOSEDIFF	0,32	0,07	4,89	p<0.01
WIN/LOSE1SWON	0,45	0,08	5,50	p<0.01
WIN/LOSE2SWON	0,05	0,11	0,47	0,64
LOSELESS11S	-0,25	0,10	-2,43	0,02
LOSELESS11BOTH	-0,25	0,08	-3,05	p<0.01
WIN/LOSE1SLOST	0,06	0,12	0,52	0,61
WIN/LOSE2SLOST	0,59	0,11	5,17	p<0.01
WINLESS11S	0,13	0,09	1,51	0,14
WINLESS11BOTH	0,15	0,08	1,89	0,07
WIN/LOSEW1L2S	-0,25	0,13	-1,90	0,07
WIN/LOSEW2L1S	0,22	0,13	1,73	0,10

On basis of results, one could carefully presume that *winning the first, respectively loosing the second set* is 'most critical' for the final outcome of the match, at least for the examined sample of entities. Winning the first set (Table 1) statistically forecasts significantly well the final outcome of the match, as well as '*loosing*' the second set. Namely, considering that stated parts of the game can be 'psychologically' decisive for the final outcome of an individual table tennis match, it would be necessary for a specific entity sample to plan two more basic strategies, when planning scholastic transformation process:

- to attempt to steer the players to focus on the importance of maximum well motoric performance and psychological engagement in *first set* of an individual table tennis match – with the goal of winning that part of the match. At the same time, additional engagement is necessary in aspiration to *prevent the defeat in second set*.
- to aspire to assure optimal motoric performance and psychological stability of an individual in situations when unfavourable outcome for the same has already occurred (when the player lost first set, respectively second set).

It is desirable to in any case inspect the proposed indexes in future researches, on multiple larger samples of examinee of players' efficiency, for the examined entity sample.

'Collective indexes' are strongly or medium strongly correlated, except EQUALIZATION.

Inclusive, all three null-hypotheses may be rejected. Namely, except from particularly strong correlation between so called *direct indicators of competition efficiency* (indexes no. 1 and 2); most of other indexes are medium strongly to strongly correlated. Same situation is with so called 'collective indexes'. Statistically significant predictive value of used indicators has been determined for the prognosis of direct indicators of efficiency (indexes no. 1 and 2) on basis of other indexes (no. 3-14). Both coefficients of multiple regression are statistically significant. However, due to sample characteristics, the generalization of results is not possible.

REFERENCES

- Brčić, B., Viskić-Štalec, N., Jaklinović-Fressl, Ž. (1977). *Predictive value of variables for the evaluation of technical-tactical elements in hand ball*. *Kinesiology*, 1/97, Vol 29, 60-70
- Grujić, A. (1975). *Table tennis*. Beograd: League for Physical Education of Yugoslavia, Partizan
- Hudetz, R. (1984). *Table tennis-techniques*. Zagreb: Sports forum.
- Krković, A. (1978). *Elements of psychometrics I*. Zagreb: SNL
- Nikolić, B. (1998). *Problem of small samples and possible solutions in kinesiology*. (internal material from lectures on postgraduate studies) Zagreb: College of Physical Education
- Sindik, J. (1999). Dependence of results in table tennis on certain indicators of game efficiency. U: Collection of papers – 2nd International professional meeting "Kinesiology – science for 21st Century", Dubrovnik (ur D. Milanović), p. 302-305. Zagreb: College of Physical Education of the University in Zagreb
- Viskić-Štalec, N. (1998). *Quantitative methods in kinesiology. (Notes from lectures on postgraduate studies of kinesiology)*. Zagreb: College of Physical Education