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Views towards Physical Activity Cards and the Effects of Cards on Students' Attitudes

Zekai Usluoglu[1], A. Dilsad Mirzeoglu[2]

[1] Bülent Ecevit University, School of Physical Education and Sports, Zonguldak, Turkey.
[2] Sakarya University, Faculty of Sport Sciences, Sakarya, Turkey.

zekaiusluoglu@gmail.com

Abstract

The aim of this study was to determine the effect of physical activity cards on the attitudes of students and to determine the views of students, parents and teachers regarding the cards. In this study, mixed model including both qualitative and quantitative approach was used. Within this context, pretest-posttest design with control group was used in the quantitative part, and phenomenological research design was used in the qualitative part. 303 students from 5th, 6th and 7th grades of a secondary school in Gökçebey District of Zonguldak Province participated in this study in 2012-2013 academic year. There were 153 students in experiment group, and 150 students in control group. The quantitative data were gathered by using "Physical Education and Sport Attitude Scale" and questionnaire forms regarding the views of students and parents. The qualitative data were gathered from PE teachers' diaries. The quantitative data were analyzed with percentage, frequency, t test for independent samples and two way repeated measures analysis of variance techniques, and the qualitative data were analyzed with descriptive analysis. When the effect of physical activity cards on students' attitudes towards lessons was analyzed, a significant difference was seen on the main effect of time x group. According to this result, the education received by students in experiment group and control group make a significant difference in countenance the posttest with regard to the level of attitudes before and after the program. On the other hand, it was found that being situated in different groups did not make a significant difference on students' attitude points. Most of the students stated that they liked the lessons, enjoyed having lessons with cards and improved their movement skills, and also having lesson with cards increased their participation. When parents' views were analyzed, most of the parents were aware of the content of cards, and their children started to take interest in sport gradually after these cards had been used. When the views of physical education teachers were analyzed, they specified that the cards increased the participation level of the students.

Keywords: Physical activity cards, physical education and sports, views, attitude

INTRODUCTION

Every human being needs movement to carry on their life in a healthier and more qualified way. This need is indispensable for them throughout their life. However, when a child gets to school-age, he/she tries to reach different goals while conducting a movement. School physical education courses play an important role in reaching these goals. According to Graham et al. (2004), there are a number of reasons why children need physical education such as doing a regular and healthy physical activity, improving their skills and physical fitness, contributing to their learning abilities in other courses, getting self-discipline, setting a target, developing leadership, cooperation and self-sufficiency, reducing stress and improving peer relationships. Doing regular physical activities or an active life style is proved to have positive effects on people's life. Specialists point out that this course should be regarded as one of the main grounds for students to gain the skill, attitude and knowledge essential to carry on their life in a more active and healthy way (Reed et al., 2007).

The applied curriculum is one of the crucial factors to get the intended efficiency from physical education and sport courses. To reach the intended learning outcomes of this course; game, gymnastics, rhythm and dance activities are practiced particularly for 1st - 3th grades at primary school, and game, rhythm and dance, sport activities, gymnastics, swimming and outdoor activities are practiced at further grades (Harrison et al., 2001; Kirchner and Fishburne, 1995). At what age and how often these activities will be practiced is closely related to individual's development characteristics (Ministry of National Education, 2006, hereinafter referred to as "MNE").

1-8th grades Physical Education curriculum, which was based on constructivism and brought into force in 2006 in Turkey, was prepared with the aim of providing fundamental, specialized, sport related skills, providing physical activities that students can use in their life, gaining emotional and social characteristics and providing active participation in the physical activities which keeps one's life healthy (MNE, 2008). According to the change made in our education system in 2012, 1-8th grades curriculum as a whole in the name of primary school was reconstituted as primary school for 1-4th grades and secondary school for 5-8th grades. According to this change, secondary school Physical Education and Sport course curriculum was prepared and brought into force in 2013-2014 academic year. Along with this curriculum, Physical Activity Cards (PACs) were developed and proposed to be used as teaching aids (MNE, 2012; MNE, 2013).

The aims of the information given and games taught through Physical Activity Cards were to make students love their school, to do activities and play games appropriate for their ages. These cards were called as TOPs cards abroad, and were one of the most efficient aids, which include high quality of physical education and physical activities, and they were produced in order to support the students in teaching departments in England and Scotland, teachers, trainers and educators working at other areas in the community. Torphe (2013) explained TOPs' features with the initial letters of SMILES and accordingly specified that these cards have success, maximum participation, inclusiveness, learning, enjoyment and socializing features. Based on MNE Physical Education and Sport Curriculum, PACs in Turkey were developed with the aim of classroom teachers', physical education teachers', trainers' and sport experts' usage within the scope of International Inspiration Project, and also TOPs cards and their programs inspired the development process. The purpose of the development of these cards was to enrich children's and youth's lives with games, physical education, sport and physical activities. PACs consist of two sets as in the original TOPs cards. The first set of the cards (yellow card group),

which is appropriate for the developmental characteristics of 6-9 years old children (1-3th grades), consists of fundamental movement knowledge and skills appearing in primary school game and physical activity course curriculum. In the second set (purple card group), there are cards appropriate for the movement education model of 10-13 years old children (4-8th grades), and these cards serve for developing common basic sportive skills which children need to have in the beginning stage of any branches of sports (Harrison et al., 2001).

A great number of articles were published in the countries that TOPs programs were used. In one of these articles, Sabin (1997) gave information about how TOPs cards were used within the curriculum. Roberts et al. (1998) analyzed the pros and cons of TOPs programs. There were several advantages of TOP cards; they were utilizable in physical education, they supported education, they helped teachers to enhance their knowledge and skills by means of received development courses. However, a lot of time needed to train teacher groups, the inadequate number of existing entrepreneurs and how they would be integrated to schools, changing the sports bags and its effect on long-term plans of the schools were accepted as disadvantages of the TOPs cards. Spode (1997) analyzed the effects of TOP game and TOP sport in eight primary schools in West Midland and pointed out that TOPs programs generally had positive effects on teaching games in these schools.

Accordingly, Hunt (1998) stated that TOPs programs had positive effects on teaching game in the schools chosen by him. Additionally, Lawrence (2003) stated that students showed a positive attitude towards physical education after TOPs training and it affected them to increase their participation in physical education course (Harris et al., 2007). In addition to these studies; Harris et al. (2007) stated that TOPs for primary schools were really suitable for the purpose of supporting primary school physical education teachers, contributing to their professional development, supporting non-expert physical education teachers in teaching physical education courses, backing up students to learn the scope of curriculum, improving the standards of physical education, increasing the level of teacher's self-confidence and enhancing their knowledge to improve physical education standard, increasing the attendance of the children in physical education and providing more enjoyable physical activity and sport facilities. Furthermore, İrez et al. (2013) reported that these cards were highly utilizable materials for skill development in physical education. In the other studies of Harris et al. (2011), they stated teachers were of the view that TOPs formed a basis for physical activities for their courses and they often used them as they were useful to enhance students self-learning.

In the light of the information above, new studies about the program are needed as PACs, developed for the purpose of supporting primary and secondary school physical education course in Turkey, were rather a new application. Therefore, the aim of this study was to analyze the effect of these cards on the attitudes of students towards physical education and sport course by determining the views of students, parents and teachers about PACs used in secondary school physical education and sport course.

METHODS

Mixed model including both quantitative and qualitative research models was used in this study. The pre-test and post-test with control group from true experimental design was used for the quantitative aspects of the study (Karasar, 2011). Furthermore, phenomenology design was used to assess the teacher's view about PACs in qualitative research design (Yıldırım and Şimşek, 2005).

Participants

Students: 303 students (146 girls and 157 boys) studying at 5th, 6th and 7th grades of a secondary school situated in Gökçebey District of Zonguldak Province in the 2012-2013 academic year spring semester participated in the study. Study was conducted through 6 classes (3 experiment group and 3 control group). The attitude scale scores towards physical education and sport course, classroom sizes, the number of girls and boys in the class were used to equalize the student numbers of experiment and control group. Percentage and frequency distribution of experiment and control group students in the study were given in Table 1.

Table 1. Percentage and frequency of the students in the study

Grade	Gender	Experiment Group		Control Group		Total		
		f	%	f	%	f	%	F
5	Girl	21	6.93	15	4.95	36	11.88	86
	Boy	27	8.91	23	7.59	50	16.50	
6	Girl	27	8.91	25	8.25	52	17.16	106
	Boy	24	7.92	30	9.90	54	17.82	
7	Girl	29	9.57	29	9.57	58	19.14	111
	Boy	25	8.25	28	9.24	53	17.49	
TOTAL	Girl	77	25.4	69	22.8	146	48.18	303
	Boy	76	25.08	81	26.7	157	51.82	

Independent samples t-test was performed to pre-test results obtained from physical education and sport course attitude scale given to 5th, 6th and 7th grades to equalize experiment and control group number and the result of the related test was given in Table 2.

Table 2. Comparison of pre-test attitude scores of students within the study

Groups	N	$\overline{X}$	Sd	SD	t
Experiment Group	153	4.02	.68	301	.570
Control Group	150	3.98	.71		

Table 2 showed that, there was no significant difference between pre-test scores of the students in experiment and control group towards physical education ($t_{(301)}$ =.570, p=.57). According to this result, it can be said that the attitude scores of the students in both groups towards physical education and sport course were similar in the beginning of this study. Students' views about PACs were received from 153 students (77 girls, 76 boys) in experiment group.

Parents: Parents' views about PACs used in Physical Education and Sport course were received as well. For this reason, 135 parents (34.1 % 5th grade, 29.6 % of 6th and 36.3 % of 7th) of 153 students in experiment group participated in the study voluntarily.

Physical education and sport teachers: Two physical education teachers using PACs in their courses were asked for their views about PACs and its applications. Both of them were male physical education teachers and carrying on their professional life teaching at the secondary school level. One

of the physical education teachers was the researcher of this study and 31 years old with 6-year physical education teaching experience. The other physical education teacher was 32 years old with 8-year physical education teaching experience. Researcher of this study received education from a PACs educator specialist in Turkey about how PACs would be used in Physical Education courses. He transferred this training to the other teacher in the school and upon such a short practice period he gave essential feedbacks to other teacher regarding PACs usage in courses.

Data Collection Tools

Attitude scale towards physical education and sport

Attitude Scale towards Physical Education and Sport developed by Demirhan and Altay (2001) was utilized in order to determine students' attitudes towards physical education and sport course. This scale consists of 24 items, 12 of which are positive (items 6, 7, 9, 10, 12, 14, 15, 16, 17, 18, 21 and 23), the rest is negative (items 1, 2, 3, 4, 5, 8, 11, 13, 19, 20, 22, 24). It is a 5-Likert Type scale. When pointing the scale, positive items were evaluated as 5- Strongly agree, 1- Strongly disagree, negative items were evaluated as 1- Strongly agree, 5- Strongly disagree. Cronbach Alpha internal consistency coefficient was calculated as α=0.93 by Demirhan and Altay (2001), and validity coefficient was calculated as 0.83 (Gülay, 2008).

View forms

Students view form regarding PACs consisted of 2 sections. In the first section, there were demographical features of the students such as grade, gender, age etc. In the second section, there were 14 questions developed by the researchers to determine students' views regarding PACs with 3 elective answers (3=yes, 2= neutral, 1= no). Parents view form regarding PACs consisted of 2 sections. In the first section, there were demographical features of the parents such as gender, occupation and age. In the second section, there were 11 questions developed by the researchers to determine parents' views regarding PACs with 3 elective answers (3=yes, 2= neutral, 1= no). While the questionnaire was being prepared, literature review was made and three academicians, who are expert on physical education and sport teaching, were asked for their opinion, and required arrangements were made upon their views. Also, in order to provide content validity while preparing student and parent view forms, two curriculum development and instruction specialists and an assessment and evaluation specialist were asked for their opinions (Tavşancıl, 2002).

Teacher diaries

Physical education teachers' views comprised the qualitative aspect of the study. Physical education teachers kept structured diaries to gather teachers' views about PACs during the study. 14 questions were presented in these diaries and after each course, which they taught with the instrument of PACs, they were asked to answer these questions in order to determine their views regarding the way they taught the course, student participation and classroom environment. Additionally, within the scope of this study, physical education teachers observed the courses regarding PACs applied to experiment groups. One of the physical education teachers was the researcher himself and both of them took part in the study as participant and observer which supported the reliability of the study.

Procedure

Ethics committee report was approved and required permissions were requested respectively. After that, the information about the study and the program was given to the principal of the school and then attitude scale towards physical education and sport lesson was applied to all 5^{th}, 6^{th} and 7^{th} grades

students as a pre-test in order to determine the experiment and control groups. After the statistical process, experiment and control groups were determined.

During this process, all the daily plans for both groups were prepared and the researcher himself and the other physical education teacher taught their courses with using PACs for 2 course hours (80 minutes) a week during 12 weeks. 5th grade experiment group students performed activities and games which are designed to develop fundamental movement skills (locomotion, balancing, manipulative and combined movements) and of yellow card groups during 12 weeks. 6th and 7th grades students were applied yellow card groups for the warm-up phase of the course; offense games, throwing and hitting games, net and racket games and active participation games were presented to them during the main phase of the course. Daily plans without PACs were used in control groups. Within that period, students in experiment group were asked for their opinions and they filled student view forms at the end of study. After 12 weeks, attitude scale towards physical education and sport course was applied to both experiment and control groups as a post-test. Parents also filled a parent view form at the end of the study. Accordingly, both physical education teachers kept diaries about their experience with PACs after each courses.

Data Analysis

The descriptive analysis method was used to analyze the qualitative data obtained through the study. Dairies kept by two teachers were computerized by researcher himself. After that, the subjects in common were transformed into short sentences and put into code. Coding was classified as themes overlapping one another by researcher and the faculty at qualitative research methods.

The descriptive statistics, independent samples t-test and two factor (Time: pre-test, post-test / Group: experiment-control) repeated measure analysis of variance were used to analyze the students' score of attitudes towards physical education and sport lesson. Significance level in the study was determined as 0.05. Percentage and frequency were used for the views of parents and students.

RESULTS

Findings about the views of the students

Great majority of 5th, 6th and 7th grade students in the study expressed their opinion in such a way that taking courses with PACs made differences in physical education and sport and they enjoyed them. They also added that PACs increased their attendance in the courses. More than half of the students stated that they did not have difficulty in practicing the cards, and cards led them to think more during the course. Moreover, taking courses with PACs provided them to be in cooperation with their mates, and PACs increased their self-confidence and made it more enjoyable (Table 3). According to these results, all of the students stated that physical education and sport courses with PACs had plenty of positive effects.

Findings about the views of the parents

When views of the parents participated voluntarily in the study were analyzed, majority of the parents stated that they were aware of the methods and content of the PACs used in physical education and sport classes since their children told them about physical education and sport course at home. PACs were used in the courses supported education and teaching, and courses with PACs changed their children's interest in the course positively. After the cards had been applied in the course their children started to become eager to physical education and sport. Furthermore, courses with PACs

contributed to their children's physical development, and PACs provided opportunities to their children to express themselves much better (Table 4).

Findings about the views of the teacher

Physical education and sport teachers using PACs in their courses stated that most of the cards were appropriate for students' levels, and students understood the cards easily. Majority of the students attended the course with PACs. Material usage in Physical Education and Sport course was great, and almost all of the students enjoyed the course and they also attended. Most of them produced ideas about the games and activities, but they sometimes had difficulty in producing ideas due to inadequate time. Moreover, most of them were respectful and they generally obeyed security precautions.

Table 3. 5th, 6th and 7th grade students' views about PACs

Questions	5th Grade Students						6th Grade Students						7th Grade Students					
	Yes		Neutral		No		Yes		Neutral		No		Yes		Neutral		No	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
1) In your opinion are there any changes in the way Physical Education and Sport courses are presented?	37	77.1	5	10.4	6	12.5	35	68.6	4	7.8	12	23.5	38	68.6	8	14.8	8	14.8
2) Did you like taking Physical Education and Sport courses with PACs?	28	58.3	9	18.8	11	22.9	37	72.5	11	21.6	3	5.9	40	74.1	11	20.4	3	5.6
3) Did taking courses with PACs increase your attendance?	29	60.4	16	33.3	3	6.3	33	64.7	13	25.5	5	9.8	44	81.5	8	14.8	2	3.7
4) Do you think taking courses with PACs is useful?	37	77.1	7	14.6	4	8.3	41	80.4	9	17.6	1	2.0	43	79.6	10	18.5	1	1.9
5) Did you like taking courses with PACs?	27	56.3	11	22.9	10	20.8	38	74.5	9	17.6	4	7.8	39	72.2	11	20.4	4	7.4
6) Do you think PACs have developed your action skills?	32	66.7	14	29.2	2	4.2	35	68.6	13	25.5	3	5.9	37	68.5	16	29.6	1	1.9
7) Did you have difficulty in practicing the games/activities on PACs?	8	16.7	7	14.6	33	68.8	8	15.7	8	15.7	35	68.6	13	24.1	14	25.9	27	50
8) Did the PACs canalized you to think?	18	37.5	20	41.7	10	20.8	33	64.7	12	23.5	6	11.8	28	51.9	14	25.9	12	22.2
9) Would you like to take all of your Physical Education and Sport courses with PACs?	17	35.4	12	25	19	39.6	17	33.3	22	43.1	12	23.5	22	40.7	13	24.1	19	35.2
10) Did taking courses with PACs provide you to cooperate?	30	62.5	13	27.1	5	10.4	41	80.4	7	13.7	3	5.9	43	79.6	9	16.7	2	3.7
11) Would you like to use the PACs in different environments? (home, street and etc.)	18	37.5	17	35.4	13	27.1	21	41.2	10	19.6	20	39.2	32	59.3	13	24.1	9	16.7
12) Did having a course with PACs increase your self-confidence?	36	70.6	10	19.6	5	9.8	35	68.6	13	25.5	3	5.9	23	42.6	27	50	4	7.4
13) Did having a course with PACs make it more enjoyable?	27	56.3	10	20.8	11	22.9	34	66.7	11	21.6	6	11.8	33	61.1	19	35.2	2	3.7
14) In your opinion did PACs manage the whole class to attend in the course?	27	56.3	13	27.1	8	16.7	24	47.1	21	41.2	6	11.8	35	64.8	13	24.1	6	11.1

Table 4. Views of 5th, 6th and 7th grade students' parents about PACs

Questions	5th Grade Students' Parents						6th Grade Students' Parents						7th Grade Students' Parents					
	Yes		Neutral		No		Yes		Neutral		No		Yes		Neutral		No	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
1) Are you aware of methods used in Physical Education and Sport courses that your children took?	22	47.8	7	15.2	17	37	23	57.5	2	5	15	37.5	22	44.9	2	4.1	25	51
2) Are you aware of the content of PACs used in Physical Education and Sport courses that your children took?	27	58.7	4	8.7	15	32.6	21	52.5	6	15	13	32.5	21	42.9	6	12.2	22	44.9
3) Do your children talk to you about Physical Education and Sport courses at home?	32	69.6	5	10.9	9	19.6	31	77.5	3	7.5	6	15	37	75.5	7	14.3	5	10.2
4) In your opinion, does the usage of PACs in Physical Education and Sport courses support education and teaching?	21	45.7	18	39.1	7	15.2	23	57.5	12	30	5	12.5	32	65.3	12	30.6	2	4.1
5) Did the PACs make Physical Education and Sport course more active?	20	43.5	19	41.3	7	15.2	17	42.5	19	47.5	4	10	23	46.9	18	36.7	8	16.3
6) Did Physical Education and Sport courses with PACs change your children's interest in the course?	24	52.2	9	19.6	13	28.3	25	62.5	10	25	5	12.5	30	61.2	12	24.5	7	14.3
7) Did your children start to become more eager to sport after PACs had been applied in the course?	26	56.5	10	21.7	10	21.7	29	72.5	5	12.5	6	15	27	55.1	14	28.6	8	16.3
8) Did PACs make your children become more active in daily life?	15	32.6	20	43.5	11	23.9	19	47.5	14	35	7	17.5	23	46.9	17	34.7	9	18.4
9) Did Physical Education and Sport course with PACs contribute to your children's physical development?	21	45.7	16	34.8	9	19.6	22	55	15	37.5	3	7.5	27	55.1	13	26.5	9	18.4
10) Did PACs provide your children to express themselves better?	21	25.7	15	32.6	10	21.7	16	40	20	50	4	10	22	44.9	13	26.5	14	28.6
11) Do you want your children's courses to go on to be taught with PACs?	32	69.6	8	17.4	6	13	21	52.5	13	32.5	6	15	28	57.1	17	34.7	4	8.2

According to the views of the teacher using PACs in their courses, PACs provided success, self-management and socializing for students, increased their attendance in the course, and developed their communication skills. PACs were also found as enjoyable and educational. However, they reported the limitations about PACs as follows: teachers were not trained enough about how to practice the cards as they were recently released materials, the fact that students needed to learn from the model that they were used to, a great number of students while practicing PACs in the class, the insufficiency of material, the lack of competitive games (especially in yellow cards), the inconvenience of the place to practice all of the cards, the fact that students with high level of skills came into prominence and that games caused an uproar in time.

Findings about the attitude levels of the students

Attitude levels of the students in experiment and control groups towards Physical Education and Sport course were also analyzed in this study and results can be found in Table 5.

Table 5. The results of two factor variance analysis for repeated measure

Sources of Variance	Tip III Sum of Squares	Sd	Average of Squares	F	p	η^2
Time (Pretest-Posttest)	4730.967	1.000	4730.967	43.882	.000	.127
Group	1361.525	1.000	1361.525	3.834	.051	.031
Time x Group	547.878	1.000	547.878	5.082	.025	.017

When PACs' effect on the attitudes of the students towards Physical Education and Sport was analyzed, a significant difference was found in the main effect of time x group. ($F_{(1-301)}$ =5.082, $p<0.05$). According to this result, the implementation that experiment and control group students had caused a significant difference in the attitude level towards Physical Education and Sport course before and after the program. Post-test attitude scores of the students in the study were found higher than pre-test attitude scores of them ($F_{(1-301)}$ =43.882, $p<0.01$). However, no significant difference was found in students' attitude scores between two groups ($F_{(1-301)}$ =3.834, $p>0.05$).

DISCUSSION

According to the results of the study, most of the 5th, 6th and 7th grade students stated that having courses with PACs made significant differences on Physical Education and Sport classes, and they enjoyed them and also they added that PACs affected them to participate in the lesson positively. Gülay (2008) reported that teaching Physical Education courses with the games were more attractive, enjoyable, motivating and they increased the attendance in the courses. Spode (1997) emphasized that students felt highly motivated in the courses with TOPs, they participated more in the activities. Likewise, Lawrence (2003) stated that TOPs program increased students' participation in Physical Education courses (cited in Harris et al., 2007). In addition to these views, plenty of the students built consensus on that having courses with PACs was useful and enjoyable and PACs increased their movement skills. Many studies support this result (Hürmeriç, 2003; İrez, 2012). Hürmeriç (2003) stated that students generally acquired skills whenever they were active in Physical Education classes. İrez (2012) reported that skill acquisition of the students increased upon the change in course content after PACs were applied, and also he added that students enjoyed the courses.

Nearly half of the parents of 5th, 6th and 7th grade students were noted that they were aware of the methods and PACs cards used in their children's Physical Education and Sport classes. Most of the parents stated that while they were talking to their children about the courses, they had sufficient knowledge of PACs cards and methods. Besides, the changes in the views of the parents of students from 5th to 7th grade students were observed in a positive way. That Physical Education course couldn't be taught effectively for various reasons till the 5th grade after that students' development level increased and therefore they conveyed these developments easily and rightly. These were among the reasons of this result. However, contrary to the findings obtained in the study, Sheehy (2006) investigated 5th grade students' perceptions of Physical Education course and upon the information obtained from their children it was determined that most of the parents had wrong information about Physical Education course program.

Two physical education and sport teachers stated that yellow and purple group PACs were suitable to 5th, 6th and 7th grade students but teachers guidance still needed. In the study, Physical education teachers applying PACs in their courses had difficulty in practicing them as they did not take proper and sufficient training for this before. Because PACs usage in physical education and sport courses was a new application in our country, teachers working as a physical education teacher in the schools of Turkey didn't take any training about this program. For this reason, PACs program caused teachers to have difficulty in understanding the cards occasionally, preparing an appropriate daily plan and practicing them. This finding of the study was supported by the views of the teachers participating in the studies of Hunt (1998) and Harris et al. (2011). For this reason, classroom teachers, physical education teachers and leaders were trained development courses for TOPs cards original of PACs and the effects of the courses were observed as rather favorable. In the study conducted by Harris et al. (2011), the effects of the training for the teachers about TOPs were experienced especially on non-Physical Education specialist and teachers having restricted teaching experience because TOPs programs have the aims of removing most teachers' deficiencies in guiding basic pedagogic subjects and planning in medium and long term and making evaluation. Furthermore, the views of the physical education teachers in the study about PACs were parallel to previous studies. Torphe (2013) determined PACs features as success, maximum participation, inclusiveness, learning, enjoyment and socializing. Teachers in the study also emphasized PACs' features as success, enjoyment, socializing, highly participation and learning based on their experiences and observations but they were not able to reach inclusive features as they didn't have retarded students in their classes.

Another finding obtained from teachers' views was that most of the yellow and purple cards were enjoyable for all of the students. Teachers also stated that students acted both in group and individually while practicing most of the cards. The results of the studies of Harris et al. (2011), Hunt (1998) and Spode's (1997; cited in Harris et al., 2007) supported the findings of the study.

Attitudes of the students towards Physical Education and Sport course were analyzed in the study. After the analysis, there was a significant difference on the main effect of time x group in the attitude scores towards Physical Education and Sport. According to this result, it can be said that the course conducted in experiment and control group caused a significant difference on the level of attitude towards Physical Education and Sport course before and after the program. Post-test attitude scores of the students increased compared to their pre-test attitude scores. This was an expected and intended result. Because it is expected by the teachers that students need to develop positive attitude towards course no matter how the course is taught or which models they use. The fact the teachers of the students in both experiment and control group were the same teachers and the time of the study might cause this result. On the other hand, it was determined that being in different groups did not cause

significant difference on the attitude scores of the students. There were not many studies to support this result of the study but this finding was supported with the studies of Gülay (2008), Lawrence (2003) and Sarıtaş (1998).

CONCLUSION and SUGGESTIONS

As a result of this study, it was observed that using PACs in Physical Education and Sport course created differences for students. They enjoyed the courses with PACs. It increased their participation in courses, provided ease of implementation, led them to think, provided them to act in cooperation, increased self-confidence, and made the course more enjoyable. It was determined that parents had the knowledge of the methods and the content of PACs; children told them about the cards; parents' knowledge about PACs' supporting the courses; PACs increased the children's motivation; the usage of the cards supported the physical development; and PACs helped the children to express themselves better. Physical Education and Sport teachers using PACs in their courses also stated that cards were comprehensible and appropriate for the level of students; they increased participation in courses; material usage was highly accessible; students enjoyed the courses; PACs provided both in group and individual participation; students respected and paid attention to security precautions. The limitations about PACs were as follows: teachers were not trained enough about how to practice the cards as they were recently released materials, the fact that students needed to learn from the model that they were used to, high classroom size while practicing PACs in the class, the insufficiency of material, the lack of competitive games (especially in yellow cards), the lack of appropriate area to practice all of the cards, the fact that students with high level of skills came into prominence and that games caused an uproar in time.

It was understood that the course conducted in experiment and control group caused a significant difference on the attitude level of students towards Physical Education and Sport course before and after the program. On the other hand, no significant difference was seen on the scores of the students in different groups.

However, it should not be forgotten that the findings of the study belong to a level of secondary school. For this reason, this point of the study must be considered while commenting on the results of the study. Accordingly, to get a more reliable result, it is highly suggested that same studies should be applied to different schools with the help of different teachers and to different grades.

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Psychological Testing, Physical Examination and Fitness Testing of Primary-School Students for Participation in Gymnastic Activities

Syed Arif Kamal[1 §], Humayun Imran Azeemi[2 $], Sadaf Rashid Khan[3 #]

[1]University of Karachi, SF-Growth-and-Imaging Laboratory, the NGDS Pilot Project, Karachi, Pakistan.
[2]University of Karachi, Department of Health, Physical Education and Sports Sciences, Karachi, Pakistan.
[3]University of Karachi, Department of Physiology, Karachi, Pakistan.

sakamal@uok.edu.pk

Abstract

The authors highlight significance of fitness testing, psychological and physical examinations for primary-school students, who wish to participate in gymnastic activities. The main purpose of pre-participation examination is safety of potential gymnasts, team members, coaches and staff. The prime function of end-of-term evaluation is performance assessment and possible improvement from the last term. Taking the example of a girl, who is participating in gymnastics, this work illustrates use of Growth-and-Obesity Roadmap in determining suitability for inclusion in gymnastic team, focusing on nutritional status, estimated-adult height and build of student. Build is computed using scaled percentiles adapted for the Pakistani children, which are generated from CDC (Centers for Disease Control and Prevention, Atlanta, United States) percentiles by fitting a parabolic curve. Mathematical-statistical definitions of normal, early, delayed, excessively delayed and precarious puberty are proposed. Approximate Tanner scores have been assigned to prepubertal, peripubertal, pubertal, adolescent and adult stages.

Keywords: Health-related fitness, skill-related fitness, stereophotogrammetry in scoliosis screening, height, mass (weight), month-wise recommendations, diet and exercise plans, lifestyle adjustment, definitions of puberty

Abbreviations: *cm*: centimeter(s) • *m*: meter(s) • *ft*: foot (feet) • *in*: inch(es) • *kg*: kilogram(s) • *lb*: pound(s) • *oz*: ounce(s) • MP: mid-parental • W/H: withheld to protect privacy

§ Professor Dr. Syed Arif Kamal, Project Director, the NGDS Pilot Project, Director, SF-Growth-and-Imaging Laboratory, Ex-Chairman, Department of Health, Physical Education and Sports Sciences, Ex-Dean, Faculty of Science, University of Karachi.
$ Humayun Imran Azeemi, Lecturer, Department of Health, Physical Education and Sports Sciences, is enrolled in MPhil leading to PhD Program of Department of Physiology, University of Karachi.
# Dr. Sadaf Rashid Khan, MBBS, is enrolled in MPhil leading to PhD Program of Department of Physiology, University of Karachi.

INTRODUCTION

Primary school coaching in gymnastics consists of aesthetic, cognitive, creative, physical, psychological and skill components, which could be using apparatus or without one (Caroll & Manners, 2003). Gymnastics deals with human-body-physiological functioning, for all-round harmonious development (Joseph, 1949). This sport is a show of strength, speed, coördination, balance and agility, requiring concentration, flexibility and devotion.

This paper discusses fitness testing, physical and psychological examinations of preteen students for participation in gymnastic activities. After deliberating on theoretical foundations of physical examination, pre-participation and end-of-the-term examinations are described, focusing on examination sequence, quality of examination, ethical and human-right protocols. The importance of puberty rating of peripubertal and pubertal gymnasts is elaborated. Growth-and-Obesity Vector-Roadmap of a young gymnast is included in the work to elaborate effect of gymnastic training on height and mass gains.

Physical examination

'Physical examination' is the examination, in which the physician uses physical senses (hearing, sight, smell, taste, touch) aided by instruments (ophthalmoscope, otoscope, stetho-scope, thermometer, *etc.*) to examine body organs (structure and function) in order to reach a diagnosis. The name makes it different from 'chemical examination' (laboratory testing involving chemical reactions) and 'radiological examination' (using ionizing radiations). The authors would like to include non-contact (clinical photography, moiré fringe topography, rasterstereo-graphy, dotted-rasterestereography) and non-invasive (pantograph for drawing spinal outline) procedures in physical examination. Good physicians do not just follow one line of thought but more than one hypothesis and use differential-diagnosis methods to eliminate all but one.

Concepts and Techniques

The mathematical concepts behind techniques used in the physical examination by a medical professional are summarized below (Kamal, 2011)**:**

a) *Symmetry* (left-right) in body shape, size, number of limbs (fingers, toes), anatomical land-marks — scapulae, body triangles, spinal dimples, shoulder/neck line, knee joints, in the context of scoliosis indicators (Kamal *et al.*, 2016*d*).

b) *Inverse Problem* — determining properties of source from the properties of field (*e. g.*, auscultation using stethoscope; the sound recorded from heart, lungs or stomach comes through the body tissue and the skin, which must be accounted for; it is obvious that auscultation over any thickness of clothing is unacceptable, scientifically), radiative-transfer equation may be used to compute intensity, if source function is known (proper interpretation of X-ray intensity in CT scan using radiative-transfer equation brought Nobel Prize in medicine; basis of clinical thermograms)

c) *Precedence Graph* — In the field of pediatrics, physical examination is the most important part of any intervention. Some checks must be performed 'before' the others. Otherwise, an undiscovered condition may affect adversely on a patient's health (Kamal *et al.*, 2002*a*). Everyone knows that an examination of the resting heart must be performed before treadmill

testing. Similarly, hernia check must 'precede' cardiac-function testing in the squatting position. 'Precedence Graphs' can show the procedures, which must precede the others. Some of the procedures can be performed 'concurrently'. For example, cardiac function in the standing position, and check for undescended testicles could be performed concurrently.

d) *Influence Graph* — In pediatrics, physical examination is the basis to start any intervention. However, some procedures 'influence' certain portions of the examination. For example, running can influence blood pressure and heart rate. 'Influence Graphs' can show various procedures influenced by others. Protocols of physical examination need to be designed in such a way that interacting procedures are performed in a laid-down sequence, or during separate sessions (Kamal *et al.*, 2002*b*).

Senses Enhanced by Instruments

The instruments used in the physical examination enhance the natural senses of physician (Table 1), sharpened and channelized by concentration and practice. Each one carries its own

Table 1. Techniques used in physical examination by a medical professional

Physical-Exam Technique	*Underlying Concept*	*Physical Sense*
Inspection	Symmetry	Sight
Auscultation	Inverse problem	Hearing
Percussion	Inverse problem	Hearing, touch
Palpation	Properties of material, body temperature	Touch
Olfaction	Inverse problem	Smell

Table 2. Instruments/Procedures used in physical examination by a medical professional

Instrument	*Purpose*	*Associated Risks*[⊆]
Stethoscope	Auscultation (heart, lungs, abdomen), blood pressure	*A*
Otoscope	Ear examination	*A, B*
Ophthalmoscope	Eye examination	
Thermometer	Recording of temperature	*A, C*
Electrocardiograph (ECG or EKG)	Recording of electrical activity of heart	*A, D*
Electroencephalograph (EEG)	Recording of electrical activity of brain	*A, D*
Electromyograph (EMG)	Recording of electrical activity of muscles	*A, D*
Magnetocardiograph (MCG or MKG)	Recording of magnetic activity of heart	
Mangnetoencphalograph (MEG)	Recording of magnetic activity of brain	
Mangnetomyograph (MMG)	Recording of magnetic activity of muscles	

[⊆]***A*:** Infection transmission through contact

***B*:** Injuring organ because of spontaneous movement

***C*:** In case of breakage, swallowing of glass pieces and mercury (toxic substance) — this is one of the reasons for abandoning the practice of taking oral temperature

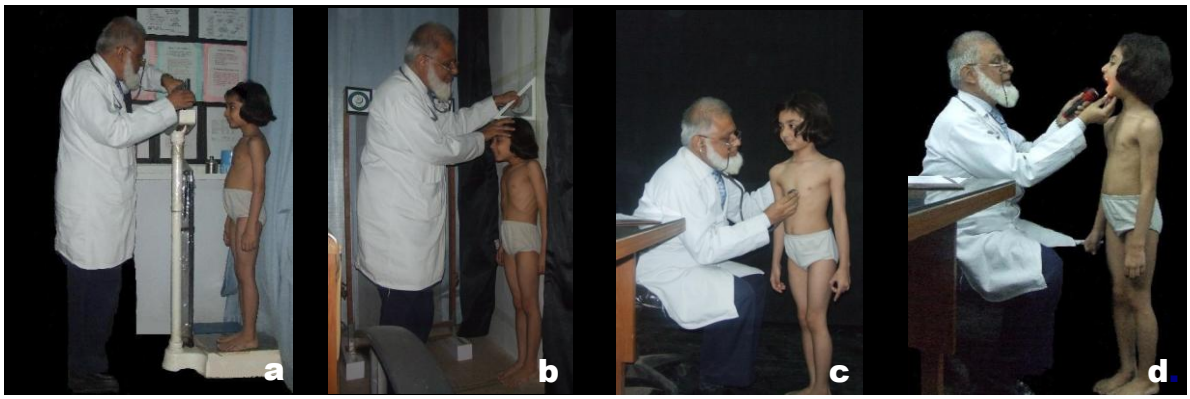
***D*:** Death from electrical shock in the absence of body-isolation mechanism

risk, which must be spelled out so that necessary precautions could be taken (Table 2).

Fitness testing, physical and psychological examinations of young gymnasts

Psychological and physical examinations as well as fitness testing are done in gender-segregated groups, whereas private-part examinations are to be conducted individually.

*Pre-Participation Examinations***:** The main objective of pre-participation psychological as well as physical examination and (health- + skill-) related fitness testing is safety of the pros-pective gymnasts, their teammates, their coaches and the gymnastic-club/the gymnastic-school staff. Besides routine anthropometry (Figures 1*a*, *b*), it is supposed to find out conditions, which

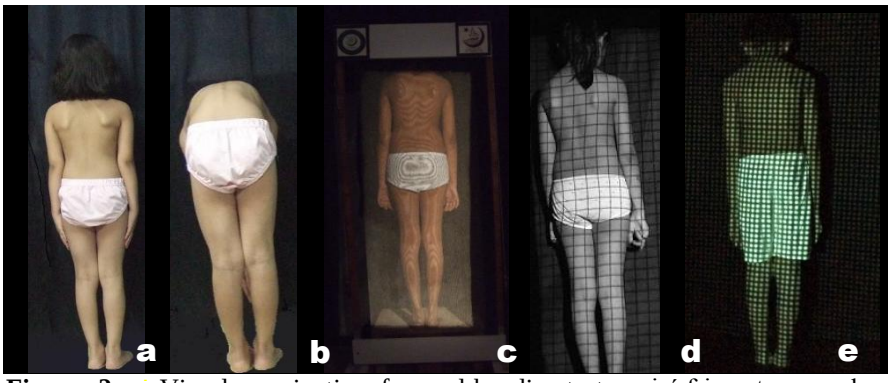


Figures 1*a-d*. Anthropometry (mass and height recording), heart-sound auscultation and mouth inspection for signs of anemia in SF-Growth-and-Imaging Laboratory — pictures of anthropometry first appeared in Kamal & Jamil (2014)

may be responsible for serious injury and harm during gymnastic activities, *e. g.*, heart problems (Figure 1*c*), epilepsy, hernia or hydro seal and correctable conditions (if detected early), *e. g.*, knees knocking. Primary focus should be on discovering communicable diseases, in particular, skin infections (so that other teammates do not get the condition), evaluation of hearing and sight (so that the prospective gymnast could follow instructions and copy routines; severe impairment may be cause of accidents in gymnasts) as well as presence of fatigue, emotional disorders and malnutrition. Acutely malnourished (Kamal, 2015*a*) and severely anemic candidates (Figure 1*d*) are not allowed to participate in gymnastic activities. In addition, psychological disorders, *e. g.*, trends of destructive behavior, anorexia nervosa and bulimia nervosa (in particular, among female gymnasts), should be looked into (Rumball & Leburn, 2004).

*End-of-the-Term Evaluation***:** This should combine psychological and physical examination with fitness testing (Kamal and Khan, 2013; 2014). It should concentrate on performance considerations and improvements achieved from the previous term. The psychological segment may contain free speech/writing as well as drawing analysis.

In both of the above health appraisals, height and mass of each gymnast should be recorded by reproducible measurers according to laid-down protocols (Kamal, 2006). Measured heights and masses should be used to generate Growth-and-Obesity Profiles (Kamal *et al.*, 2011) as well as Growth-and-Obesity Roadmaps (Kamal *et al.*, 2015*a*; 2016*a*; *b*) of gymnasts. Maintaining optimal-weight-for-height (Kamal, 2015*c*) is of prime importance for efficient and effective participation in gymnastics. End-of-the-Term Evaluation should, also, include a detailed exami-nation of posture and gait, both walking and running (Kamal *et al.*, 2016*c*). Scoliosis screening (Kamal *et al.*, 2015*b*) using visual examination (Figure 2*a*), forward-bending test (Figure 2*b*) and



Figures 2*a*-*e*. Visual examination, forward-bending test, moiré fringe topography, rasterstereography and dotted-rasterstereography for detection of scoliosis — pictures of visual examination, forward-bending test, rastersterography and dotted-rasterstereography first appeared in Kamal *et al.* (2016*d*)

moiré fringe topography (Figure 2*c*) should be a part of every evaluation (Akram and Kamal, 1991; Kamal *et al.*, 2013*f*). In addition, rasterstereography (Kamal *et al.*, 2013*b*) and dotted-rasterstereography (Wasim *et al.*, 2013) may be employed, where relevant software is available (Figures 2*d*, *e*).

Health Surveillance of Gymnasts

The gymnasts, who show slightest deviation from normal health status, during daily inspection upon arrival, should receive head-to-toe unclothed checkup by doctor-on-duty before being allowed to mix with other teammates. A complete, stripped examination of any gymnast, reporting for even a minor cut or a bruise, is mandatory to rule out internal injuries, abrasions and damages to other body parts. Self-diagnosis and self-treatment, beyond essential first aid, should be avoided; as such practices are uncoördinated with history and etiology of the disease. Self-medication runs the risk of adverse drug interaction.

Preparation for Pediatrician's Office Visit

The following timeline is proposed to get maximum value from such visit.

*One week before the proposed visit***:** Parents should start brainstorming the points (*i. e.*, jot them down without consideration of logical sequence), which should be included in note to pediatrician — progress/problems since last check up, medicines/treatments taken, areas the parents wish the pediatrician to look for, get advice from pediatrician.

*Four days before the proposed visit***:** Parents should organize, in a sequence, the points collected — date-wise progress, problems, from most important to least important for areas the parents wish the physician to concentrate on and provide recommendations.

*Two days before the proposed visit***:** Parents should collect medical records, brief children about the upcoming examination, making it crystal clear that they have to undress during the examination, show them a video/a drawing or conduct an activity related to well-child visit.

*One day before the proposed visit***:** Parents should conduct mock check up (children stripped to waist, wearing only briefs/panties), call pediatrician' office to confirm appointment, write down or type out (preferred) note for doctor containing points organized three days ago.

*Day of proposed visit***:** Hair of girls should be left open with only hair band used to restrain hair. Parents should bring ponies for each of their daughters to be used during fitness-testing segment, dress children in appropriate footwear and clothing, which can be easily removed by children themselves (Table 3). Avoid garments that open in the back, belts for boys and shoes

Table 3. Hairstyle, clothing and footwear for free play and observation, psychological testing, physical examination and fitness testing of primary- school children for participation in gymnastic activities

Session	*Boys*	*Girls*
HAIRSTYLE		
Free Play and Observation[∀]	Very short hair	Hair completely unbraided and opened up — only hair-band allowed to hold hair from front
Psychological Testing	Very short hair	Hair completely unbraided and opened up — only hair-band allowed to hold hair from front
Physical Examination	Very short hair	Hair completely unbraided and opened up — all accessories stored in numbered boxes
Fitness Testing[∃]	Very short hair	Long hair should be tied in the form of (hair) bun using pony, exposing the upper-neck area
CLOTHING		
Free Play and Observation[Σ]	*Younger*: Vest and shorts (with briefs) *Older*: T-shirt and trousers (with briefs)	*Younger*: Vest and miniskirt (with panties) *Older*: T-shirt and skirt (with panties)
Psychological Testing	Shorts or trousers (with briefs), stripped-to-waist*	Miniskirt or skirt (with panties), stripped-to-waist*
Physical Examination	White[⊇] briefs only, legs exposed from upper thighs to feet, stripped-to-waist	White[⊇] panties (knickers) only, legs exposed from upper thighs to feet, stripped-to-waist
Fitness Testing[∃]	White[⊇] briefs only, legs exposed from upper thighs to feet, stripped-to-waist	White[⊇] panties (knickers) only, legs exposed from upper thighs to feet, stripped-to-waist
FOOTWEAR		
Free Play and Observation[Ξ]	White pure-cotton socks + black pure-leather (mocation) shoes with foot support	White pure-cotton socks + black pure-leather (mocation) shoes with foot support
Psychological Testing	White pure-cotton socks + black pure-leather (mocation) shoes with foot support	White pure-cotton socks + black pure-leather (mocation) shoes with foot support
Physical Examination	Barefoot	Barefoot
Fitness Testing[∃]	Barefoot	Barefoot

[∀] Gymnast is observed unaware for 10 minutes for social interaction with parent(s) and other children as well as passive observation of hair.

[∃] Fitness testing includes routines of gymnastic activities — hairstyle, clothing and footwear must take care of this aspect. Untied hair of girls pose risk of obstructing vision by coming in front of eyes in addition to tangling in the apparatus (Kamal & Khan, 2015).

[Σ] Absolutely nothing is to be worn under vest or T-shirt, which must be put on only dry skin. Disinfectant powder is to be applied on dry skin before wearing underpants.

* Passive observation of posture and gait (with shoes on), concentrating on upper torso, is conducted during walking, standing (free speech), sitting (on chair/free writing), sitting (on floor/working on jigsaw puzzle) and drawing various figures (self, family) on whiteboard in this segment of examination.

[⊇] White color is needed to conduct moiré and raster examinations (Kamal & Khan, 2015).

[Ξ] Disinfectant powder is to be applied between toe and thumb as well as between toes before wearing clean socks on dry feet.

having shoelaces. When weather is pleasant, boys may be dressed in shorts/trousers with white briefs; girls in miniskirt/skirt with white panties, adding T-shirt/vest, if desired (nothing under T-shirt/vest).

*Upon arrival in the pediatrician's office***:** Parents should inform the receptionist and, when called for psychological examination, ask the children to remove T-shirt or vest. The children keep on miniskirts/shorts/skirts/trousers, shoes and socks during psychological examination and passive observation of posture (conducted in groups of same gender). Afterwards, they are instructed to remove garments below waist and footwear retaining only underwear to be sent to gender-segregated play area. The pediatrician gets useful orthopedic and neurological information from observation and video recording of free play of partially dressed youngsters. Parents should refuse gowns for their children (if offered by pediatrician's office),

*After the examination is completed***:** Parents should instruct the children to get dressed, ask the pediatrician to brief them about the examination findings and give specific recommendations. Also, inquire the caregiver, when to bring their offsprings, again, for a follow-up visit.

The Examination Sequence

Instead of head-to-toe sequence the examinations are performed according to precedence and influence graphs established for each routine (Kamal *et al.*, 2002*a*, *b*). The depth and the breadth of examination should be guided by history (physical, psychological, social and economic, including history of one day). The contents of examination should be defined in writing. All findings should be documented. Both overt (gymnast knows that examination is being conducted) and covert (gymnast is unaware of assessment being performed) examinations have diagnostic values. Posture and gait may be better observed in a covert examination. A clinical summary should be prepared, which would become part of gymnast's medical record.

Mode of Undressing

For children, there are three modes of undressing in practice among the clinical community worldwide**:**

a) Undress the children to skin (everything removed) in the beginning. The children remain unclad till the end of examination.

b) Strip the youngster to briefs or panties (all clothing above the waist taken off) in the beginning. The underpants are, later, removed for genital (puberty rating for relevant ages), orthopedic (fine observation of posture and gait) and skin (to rule out communicable diseases) examinations.

c) Unclothe boys and girls as the examination progresses — allows pediatrician to observe examinees' fine motor skills involved in undressing.

For school checkups, *b*) is recommended, whereas for a more detailed checkup, like the one proposed in this work, *c*) is preferred.

At the ages in question (5-10 *years*), gowns should not be used during the examinations — extra cost, wastage of time in putting on and removing during various parts of examination, difficult to change into and keep on the body by youngster, child becomes more conscious of undressing, obstruct proper examination of posture, gait and skin conditions, cloth-gown strings become sources of infection transmission as they can not be washed properly. Its strings could get tied into the necks of younger ones and strangulate them. In one school, when the first author measured 5-*year*-old students, teachers removed their clothes for anthropometry, but they had to put clothes back on themselves. No help

provided! Took one hour, but they learnt to wear their uniforms, otherwise they had to return to class in a state of undress. This exercise was, therefore, transformed into an activity to practice self-dressing.

For psychological testing as well as passive observation of posture and gait (to detect gross abnormalities) the potential gymnasts are asked to strip-to-waist. Girls should have their hair open, only held by a hair band. For physical examination and fitness testing, gross observation of posture and gait as well as 3-D-surface and -motion analyses, anthropometry and partial skin examination, the incumbent must remove everything (including shirt/T-shirt/vest/blouse/dress, miniskirt/shorts/skirt/trousers, shoes, socks/stockings/leggings, accessories — belt, bow, cap, hair band, hair clips, hair pins, jewelry, scarf, tie, watch) except short underpants. During physical examination, hair must be unbraided and opened up for a detailed checkup. For fitness testing, hair should be tied up in the form of (hair) bun using pony to leave neck-area exposed (Table 3).

Briefs or panties should be taken off for genital (signs of sexual abuse, venereal diseases), fine motor (gait), orthopedic (cerebral palsy, posture, rickets, trunk deformities), nutritional-status (signs of neglect) and skin (signs of physical abuse, skin cancers) examinations. Net mass (mass with nothing on) may, also, be noted during this segment. These exams should be grouped together to minimize time for the examinee to remain totally stripped and must be conducted individually.

Quality of Examinations

The most important factors, taken to consideration by the parents, while selecting a pediatrician for their children, may be summarized as**:**

a) The pediatrician examines the child gymnasts most thoroughly. Child gymnasts are appropriately undressed for each part of examination.
b) The pediatrician explains every step to the child gymnast (whenever possible) and discusses thoroughly the findings with the parents in the end.
c) The pediatrician has an unhurried approach to the examination.
d) The pediatrician is friendly to the child gymnast and courteous to the parents.

In fact, the key to an effective examination is establishing initial rapport with the examinee, which should be retained throughout the checkup by conversation with the parents as well as the child. The examiner should start the examination by moving not too fast and refraining from sudden, jerky movements. The health-care provider should be gentle but firm in dealing with the youngster (Alexander & Brown, 1979).

A good pediatrician has, *not only*, learnt the science of examination — mastered techniques, knows normal range of tests for the specific age group, *but also*, the art of examination — efficient conduct of examination in optimal time, effective communication (communicate *with* the parents; not communicate *to* the parents) and persuasion skills to inculcate good health habits in family (Ferholt, 1980).

The parents were displeased, if any of the following happened during the examination of their children**:**

a) A part of the examination was omitted (mainly, genitals, scoliosis check, puberty rating).
b) The pediatrician did not inform the child gymnast before conducting a certain portion of the

examination.

c) The caregiver did not explain the results to parents after the conduct of examination — when results were explained, medical jargon was used, which could not be understood by parents (asking for education and occupation of each parent in the history form should give the doctor clues to the depth and the breadth of medical knowledge of each parent —Additional File 1**:** http://www.ngds-ku.org/Papers/J48/Additional_File_1.pdf; pages 5, 11). At times, physician used a foreign language (*e. g.*, English) to communicate with the parents, forgetting that English was not the common language of masses in that part of the world.

d) Examination was not performed thoroughly (mainly, auscultation of heart over shirt/gown or reaching under shirt/gown; taking of blood pressure over shirt sleeve).

The pediatricians should have evaluation forms in easy-to-understand language, to assess quality of care offered by their offices, which should be filled out by parents and, also, older child gymnasts.

Ethical and Human-Right Protocols

Each office should comply with the ethical and the human-right protocols applicable in the respective region. The pediatrician should seek parental permission before starting the examina-tion. Consent should be taken, again, from the parent before conducting examination of private parts.

All clinical studies should be approved by the appropriate bodies, in case of examination of children enrolled in a gymnastic school or a gymnastic club; the relevant body is 'Institutional Review Board', formed by the respective Board of Governors (Karlberg *et al.*, 1998).

The NGDS Pilot Project (http://ngds-ku.org) passed through 'Institutional Review Process' by authorities of University of Karachi, which included committees of Chancellor (Governor, Province of Sindh, Pakistan), Vice Chancellor and Dean, Faculty of Science. Subsequently, the project was scrutinized by Commanders of the Armed-Forces of Pakistan as well as Principals of the participating institutions (Kamal *et al.*, 2002*c*). Interactive sessions were conducted for students, teachers and school-health teams. Detailed written and verbal instructions were provided to students. Measuring equipment was shown to them a day in advance. Older students were invited to participate in height-scale mounting and handling of equipment to generate interest. Verbal consent was taken prior to checkup. Section at the end of this paper discusses confidentiality issues and informed consent. Additional File 1 gives details of project protocols.

Right to the Second as well as the Third Opinion

The parents have a right to know the exact nature of disease their child is suffering from, in language, which they are able to understand, with different options of treatment available. Benefits and risks of each one should be explained to them by their caregiver. For surgeries, amputations and other such invasive procedures, the second and even the third opinion should be sought before making the final decision.

In 2015, Faculty of Pharmacy, University of Karachi established Drug Information Center in University Clinic to educate their students as well as employees and their families about the side effects of medicines prescribed to them.

Hygiene, Patient Comfort and Privacy

Attempt should be made to comply with JCI (Joint Commission International) infection-control protocols. Physicians and anthropometrists should wash and sanitize hands, remove hand-worn chains, rings and wristwatches (for safety reasons) before starting examination. This exercise should be repeated after the conduct of examination of genitalia. Thermometers should be placed in the armpit instead of mouth. The thermometer bulb should be placed in dettol-mixed water, when not in use to record temperatures (generic name of dettol is chloroxylenol).

A year ago, the entire floor of SF-Growth-and-Imaging Laboratory was reconstructed using black tiles. Outside shoes cannot be worn in lab area by children, parents or even staff. Floor is mopped at the start of each session with dettol-mixed water.

Comfort of children is of prime concern. Even in mild weather, fans are not turned on, as children are unclothed for examination. In colder weather, physicians should warm hands before palpation and percussion. Similarly, diaphragm and bell of stethoscope should be warmed before auscultation.

Both acoustic as well as visual privacy is offered in SF-Growth-and-Imaging Laboratory. Doors are closed and locked and second level of privacy is offered through a curtained-off area. Although, both parents are encouraged to come to the examination session and share history and progress (during the very first session, heights of biological father and biological mother are measured to compute target height), same-gender parent is preferred to accompany actual physical examination in the curtained-off area.

Puberty rating of Gymnasts

It is, strongly, recommended that puberty rating based on Tanner scales must be conducted at every checkup for peripubertal and pubertal gymnasts (Tanner, 1962). Because of energy channelization due to vigorous routines of gymnastics, these students often experience 'delayed puberty', which may result in not achieving their full potential in terms of height gain (Kamal & Jamil, 2012). A very well known case is of Romanian gymnast Nadia Elena Comăneci.

Table 4. Tanner scoring and stages of puberty[£]

Stage of Puberty	*Tanner Scor*
Prepubertal	1
Peripubertal	2
Pubertal	3
Adolescent	4
Adult	5

[£]Approximate Tanner scores assigned to stages of puberty by the authors; in case there were different scores in various segments, an average (arithmetic mean) was taken to assign score

According to the Wroclow Growth Study (WGS) and the Wroclow Longitudinal Twin Study (WLTS), the growth and the maturity characteristics of gymnasts are different from other sports (Malina & Bielicki, 1996)**:** gymnastics is the only sport that presents a profile of short stature in both sexes; …., though data are not extensive and female participants in gymnastics, ballet, and figure skating present later sexual and skeletal maturation.

Prepubertal, Peripubertal and Pubertal Children

Peripubertal children are those, who are about to enter puberty. The height function levels off (height velocity approaches zero) according to ICP model of Karlberg (1987). Pubertal children are those, who

have started to enter puberty. Adolescents are classified as individuals, who have achieved puberty. Table 4 gives the approximate Tanner classification (Goldbloom, 1992) proposed by the authors.

Age of Onset of Puberty and Classification of Puberty

Age of onset of puberty is of utmost importance for a gymnast. We define this as the age when Tanner stage of 3 (arithmetic mean of 'thelarche' and 'adrenarche' in girls; equivalent average in boys) is achieved (Behrman & Vaughan III, 1983). If $A_{\text{Onset}-\text{Puberty}}$ represents age of onset of puberty for a gymnast, $\mu_{\text{Onset}-\text{Puberty}}$ gender-specific mean age of onset of puberty for a certain country and $\sigma_{\text{Onset}-\text{Puberty}}$ gender-specific standard deviation for age of onset of puberty for that country, we define 'normal puberty' if the age of onset of puberty lies within one standard deviation of the mean age — Equation cum Inequality (1)

(1) $$\mu_{\text{Onset}-\text{Puberty}} - \sigma_{\text{Onset}-\text{Puberty}} \leq A_{\text{Onset}-\text{Puberty}} \leq \mu_{\text{Onset}-\text{Puberty}} + \sigma_{\text{Onset}-\text{Puberty}}$$

The gymnast is considered to experience 'early puberty' ('early bloomer' in layman language) if the age of onset lies between two and one standard deviation each subtracted from the mean age — Equation cum Inequality (2)

Table 5. Nutritional-status classification for career of a child gymnast

Classification	*Description*	$P_{\text{Scaled}}(h),\ STATUS_{\pm}(h)^{\Leftrightarrow}$	$P_{\text{Scaled}}(\mu),\ STATUS_{\pm}(\mu)^{\Leftrightarrow}$
Acute Malnutrition	Severe Stunting + Severe Wasting	$P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) < 6^{\P}$	
Under-Nutrition	Stunting + Wasting	$STATUS_{\pm}(h) < 0$	$STATUS_{\pm}(\mu) < 0$
Energy-Channelization I	**Tallness + Wasting**	$\boldsymbol{STATUS_{\pm}(h) > 0}$	$\boldsymbol{STATUS_{\pm}(\mu) < 0}$
Energy-Channelization II	Stunting + Obesity	$STATUS_{\pm}(h) < 0$	$STATUS_{\pm}(\mu) > 0$
Over-Nutrition	Tallness + Obesity	$STATUS_{\pm}(h) > 0$	$STATUS_{\pm}(\mu) > 0$
Energy-Channelization III	Puberty-Induced Energy-Channel.	Height gain levels off	Below waist fat & mass gain

$^{\Leftrightarrow}P_{\text{Scaled}}(h)$: Scaled Percentile-of-Height • $P_{\text{Scaled}}(\mu)$: Scaled Percentile-of-Mass • $STATUS_{\pm}(h)$: Algebraic Status (pertaining-to-height) • $STATUS_{\pm}(\mu)$: Algebraic Status (pertaining-to-mass)

¶Modified definition proposed in Kamal *et al.* (2017*b*) adapted for scaled percentiles — section on 'Growth-and-Obesity Roadmaps of a Gymnast' explains scaled percentiles obtained by fitting a parabolic curve to CDC percentiles

(2) $$\mu_{\text{Onset}-\text{Puberty}} - 2\sigma_{\text{Onset}-\text{Puberty}} \leq A_{\text{Onset}-\text{Puberty}} < \mu_{\text{Onset}-\text{Puberty}} - \sigma_{\text{Onset}-\text{Puberty}}$$

The gymnast is supposed to exhibit the phenomenon of 'delayed puberty' ('late bloomer' in layman language) if the age of onset lies between one and two standard deviations each added to the mean age — Equation cum Inequality (3)

(3) $$\mu_{\text{Onset}-\text{Puberty}} + \sigma_{\text{Onset}-\text{Puberty}} < A_{\text{Onset}-\text{Puberty}} \leq \mu_{\text{Onset}-\text{Puberty}} + 2\sigma_{\text{Onset}-\text{Puberty}}$$

The gymnast may be having 'excessively-delayed puberty' if the age of onset is more than two standard deviations added to the mean age — Inequality (4)

(4) $$A_{\text{Onset}-\text{Puberty}} > \mu_{\text{Onset}-\text{Puberty}} + 2\sigma_{\text{Onset}-\text{Puberty}}$$

'Precarious puberty' is defined by our group as the condition in which the age of onset is less than two standard deviations subtracted from the mean age and sum of scaled percentiles of height and mass (see next section) falls below 100, Inequalities (5*a*, *b*), which means that the child enters puberty without experiencing associated puberty-induced energy-channelization, also termed as energy-channelization III (Table 5).

(5*a*, *b*) $A_{\text{Onset}-\text{Puberty}} < \mu_{\text{Onset}-\text{Puberty}} - 2\sigma_{\text{Onset}-\text{Puberty}}$, $P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) < 100$

If the sum of percentiles is equal to or above 100, the child is considered to experience 'excessively-early puberty', which needs to be differentiated from 'precarious puberty' to prevent over-treatment (Kamal *et al.*, 2013*g*).

Let us illustrate the above concepts with numbers given by Ayatollahi *et al.* (2002) regarding age of onset of puberty, $\mu_{\text{Onset}-\text{Puberty}} \pm \sigma_{\text{Onset}-\text{Puberty}} = (12.91 \pm 1.23)$ *years*, in Iranian girls. According to Equation cum Inequality (1), 'normal puberty' corresponds to the age range (11.68-14.14) *years*, end-points included. According to Equation cum Inequality (2), 'early puberty' is associated with the age range (9.45-11.68) *years*, left-end-point included. According to Equation cum Inequality (3), 'delayed puberty' is experienced, when the age of onset lies in the age range (14.14-15.37) *years*, right-end-point included. According to Inequality (4), a girl is having 'excessively-delayed puberty' if the age of onset exceeds 15.37 *years*. According to Inequalities (5*a*, *b*), 'precarious puberty' is classified, when the age of onset is less than 9.45 *years* and the child is not experiencing energy-channelization III (puberty-induced energy-channelization), *i. e.*, $P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) < 100.$ If the child is experiencing energy-channelization III, *i. e.*, $P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) \geq 100,$ combined with age of onset of puberty earlier than 9.45 *years*, youngster is classified as having 'excessively-early puberty'.

Ayatollahi *et al.* (2002) concluded that body-mass index as well as socio-economic status (SES) had the most dominant effects on menarcheal-age variation in the context of a unified statistical model — for wasted girls menarcheal age was delayed, whereas it decreased as SES improved. Bone-growth study in peripubertal and pubertal gymnasts becomes most important to prevent sport-related injuries (Magarey *et al.*, 1999).

Growth-and-obesity roadmaps of a gymnast

'Growth-and-Obesity Profile' is a snapshot of health status of growing gymnast, which includes status (pertaining-to-height) and status (pertaining-to-mass). Such a profile can be generated after the first checkup, allowing the pediatrician to intervene in cases, where waiting for the second checkup (to determine growth velocity and rate of weight or loss) may not be recommended, *e. g.*, the case of acute malnutrition (Kamal, 2015*a*). It is prepared based on methods given in Kamal *et al.* (2011). 'Growth-and-Obesity Scalar-Roadmap' is a collection of

Growth-and-Obesity Profiles, which gives build (Figure 3), nutritional-status classification

Classification	*Scaled-Percentile Range*	*Dominating Function*	*Suitable for*
Small	$0 \leq P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) < 50$	**Brain**	**Intellectual work, planning and development**
Medium	$50 \leq P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) < 150$	**Body and brain functions equally contributing**	**May adapt to body- or brain-dominating tasks**
Big	$150 \leq P_{\text{Scaled}}(h) + P_{\text{Scaled}}(\mu) < 200$	**Body**	**Tasks involving strength and speed**

Figure 3. Classification of build of a child gymnast

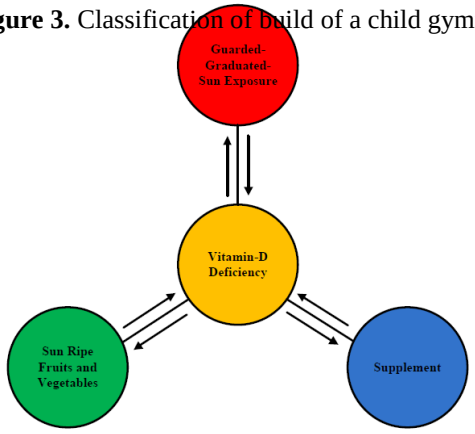


Figure 4. Measures to overcome vitamin-D deficiency — first appeared in Kamal (2017)

(Table 4) and month-wise recommendations (on the checkup date of each successive month for the next 6 *months*) to gain height and shed off/put on mass (weight), along with lifestyle adjustment, diet and exercise plans to achieve each of these targets (Kamal *et al.*, 2013*a*; *d*), with an emphasis on overcoming vitamin-D deficiency (Figure 4), as all diet-based interventions become ineffective if this condition exists (Kamal *et al.*, 2013*c*). The method was presented, originally, in Kamal *et al.* (2015*a*) and explained in detail in Kamal (2015*a*). Recently, month-wise recommendations have been fine-tuned in the light of height- and mass-gain trends suggested by ICP model (Karlberg, 1987). The modified model is given the name 'Growth-and-Obesity Vector-Roadmap' (Kamal *et al.*, 2016*a*; *b*).

Anthropometry

For measuring height (stature), the undressed student gymnast was required to stand touching the engineering tape (mounted on wall, vertical alignment checked through plumb line) and instructed to align hands with body, palms touching thighs and heels together (Figure 1*b*). Height was measured, when the youngster fully inhaled so that the incumbent's chest was expanded and tummy was in (attention position). The anthropometrist held a pencil at eye level to make sure that chin of the incumbent was parallel to floor. For measuring mass (weight), the stripped student gymnast stood in beam-scale center (Figure 1*a*), palms on thighs and feet separated, looking straight and breathed in to trap maximum air (stand-at-ease position). A standard 100-*cm* ruler and a standard 2-*kg* mass were used to calibrate height- and mass-measurement instruments at the beginning of each daily session along with noting down of zero errors. Disrobing helped ascertain proper posture, non-flexing of elbows and knees

as well as complete inhaling (Figures 1*a*-*d*). Step-by-step procedures are given in Kamal (2006). The anthropometric measurements were taken by anthropometrists with documented accuracy and precision (Kamal *et al.*, 2013*e*) — mathematical definitions of accuracy and precision are given in Kamal (2009). During 2012-2015, heights and masses were measured to least counts of 0.01 *cm* and 0.01 *kg*, respectively, in SF-Growth-and-Imaging Laboratory (Kamal, 2010). Since 2016, the least counts have been upgraded to 0.005 *cm* and 0.005 *kg*, respectively (Kamal *et al.*, 2016*b*).

Heights Important for a Gymnast

Student gymnast's estimated-adult height (Table 6) is obtained by mathematical extrapolation of the student's measured height trajectory to 20 years — may be termed as 'the navigational curve' (pertaining to actual values). This height is, mainly, the prime selection criterion in gym-nastic teams. However, the incumbent's height could be 'controlled' by suitable interventions — lifestyle adjustment, diet and exercise plans (Kamal *et al.*, 2013*d*). These plans should be integrated in such a way that the net effect is reduction in sedentary behavior (Straker *et al.*, 2016).

Target (Adult-mid-parental) height of boy (girl) is computed by adding (subtracting) 6.5 *cm* to (from) average (arithmetic mean) of heights of biological father and biological mother (Tanner *et al.*, 1970). Target height may be extrapolated backwards to current age; the resulting curve generated may be visualized as 'the guidance curve' (pertaining to reference values), provided target height exceeds army-cutoff height or estimated-adult height (Kamal *et al.*, 2016*a*). Otherwise, army-cutoff height or estimated-adult height (whichever is greater) is taken as reference. Army-cutoff height is the least height required for induction into the Armed Forces of a certain country. In Pakistan, this height is 5 *ft* 4 *in* (162.56 *cm*), corresponding to 3rd (2.72 to be exact) percentile for males and 5 *ft* 2 *in* (157.48 *cm*), corresponding to 19th (19.36 to be exact) percentile for females (Kamal *et al.*, 2017*a*).

Scaling of Percentiles for the Pakistani Gymnasts

A parabolic curve, Equations (6*a*, *b*), was fitted to transform percentiles obtained from

Table 6. Heights important for career of a child gymnast

Nomenclature	*Depends on*	*Corresponding Percentile*
Estimated-adult height, $h_{\text{est-adult}}$	**Student's height**	**$P(h)$**
Target (Adult-mid-parental) height, h_{MP}	Parents' heights	P_{MP}
Army-cutoff height, h_{AC}	Country-wide standards	P_{AC}

Table 7. Scaling of percentiles to be used for the Pakistani gymnasts

$P_{\text{CDC}}(h), P_{\text{CDC}}(\mu)$	→	$P_{\text{Scaled}}(h), P_{\text{Scaled}}(\mu)$
0	→	0
40	→	50
100	→	100

Extended CDC Growth Charts (Kamal & Jamil, 2014), $P_{\text{CDC}}(h)$ and $P_{\text{CDC}}(\mu)$, to scaled percentiles, $P_{\text{Scaled}}(h)$ and $P_{\text{Scaled}}(\mu)$, applicable for the Pakistani population, satisfying the conditions given in Table 7 (Kamal *et al.*, 2015*a*).

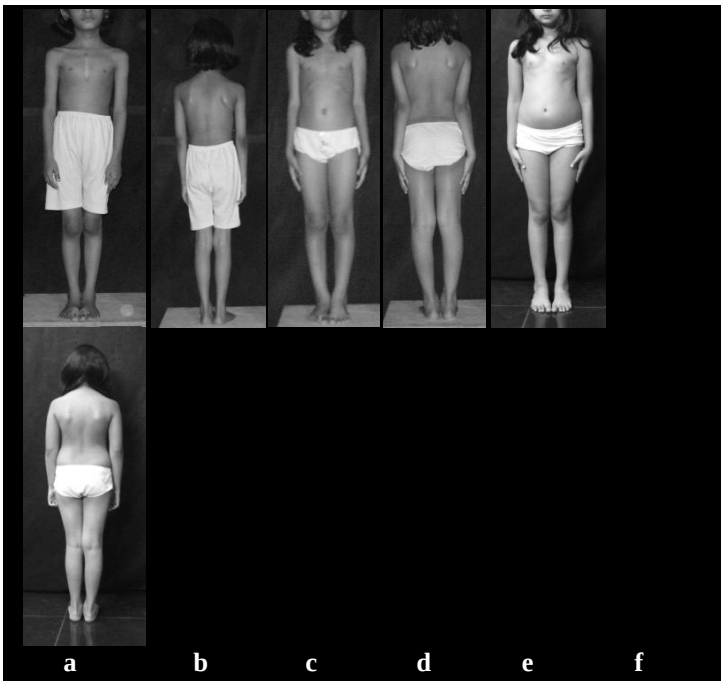
(6*a*, *b*) $$P_{\text{Scaled}}(h)=\frac{17P_{\text{CDC}}(h)}{12}-\frac{P^2_{\text{CDC}}(h)}{240};\ P_{\text{Scaled}}(\mu)=\frac{17P_{\text{CDC}}(\mu)}{12}-\frac{P^2_{\text{CDC}}(\mu)}{240}$$

The extended growth charts and tables contain entries for 0.01^{th}, 0.1^{th}, 1^{st}, 99^{th}, 99.9^{th} and 99.99^{th} percentiles for heights and masses in addition to entries for 3^{rd} to 97^{th} percentiles. The expression for 'severity of acute malnutrition' (Kamal, 2015*a*), when present, takes the form

(7) $$\textit{Severity of Acute Malnutrition}=100\left(1-\frac{P_{\text{Scaled}}(h)+P_{\text{Scaled}}(\mu)}{6}\right)\%$$

Build of a Gymnast

A child having equal contribution of brain and body functions (medium build) may be the most suitable for gymnastic activity. Build is classified as 'small, 'medium' and 'big' on the basis of sum of scaled percentiles of height and mass (Figures 5*a-f*). Note that LG had a 'medium' build, when she started gymnastics. The sport made her gain height rapidly, shifting her build to 'big' (Kamal & Khan, 2015). The children exhibiting the phenomenon of energy-channelization I, *i. e.*, those who are tall and wasted (Kamal *et al.*, 2014; 2015*a*), are, generally,



Figures 5*a-f*. From left to right, posture photographs of children exhibiting (***a***, ***b***) small build (GR**:** SGPP -KHI-20110412-02/02; age 7 *years* 6 *months* 11 *days* on May 13, 2012; sum of scaled percentiles 3.65), (***c***, ***d***) medium build (ZHZ**:** SGPP-KHI-20110412-01/01; age 6 *years* 10 *months* 27 *days* on May 13, 2012; sum of scaled percentiles 95.33) and (***e***, ***f***) big build (LG**:** SGPP-KHI-20131021-02/01; age 8 *years* 7 *months* 11 *days* on March 26, 2016; sum of scaled percentiles 174.18)

Table 8*a*. Month-wise height and mass (weight) management for a girl practicing gymnastics, LG (SGPP-KHI-20131021-02/01)

Target Date	*Height Target*		*Mass (Weight) Target*	
	cm	*ft-in*	*kg*	*lb-oz*
April 26, 2016	147.78	4 *ft* 10.18 *in*	30.93	68 *lb* 3.30 *oz*
May 26, 2016	148.28	4 *ft* 10.38 *in*	31.84	70 *lb* 3.36 *oz*
June 26, 2016	148.80	4 *ft* 10.58 *in*	32.98	72 *lb* 11.44 *oz*
July 26, 2016	149.30	4 *ft* 10.78 *in*	34.34	75 *lb* 11.49 *oz*
August 26, 2016	149.82	4 *ft* 10.99 *in*	35.71	78 *lb* 11.80 *oz*
September 26, 2016	150.34	4 *ft* 11.19 *in*	37.04	81 *lb* 10.91 *oz*

selected in the gymnastic teams. However, only the first- and the second-degree-wasted children should be allowed to participate in gymnastic activities for safety reasons (Kamal & Khan, 2015). The scaled percentiles are used to determine build of a gymnast.

Table 8*a* lists month-wise height and mass (weight) management of LG, a girl participating in gymnastics, based on Growth-and-Obesity Vector-Roadmap model (Kamal *et al.*, 2016*a*; *b*). Additional File 2 (http://www.ngds-ku.org/Papers/J48/Additional_File_2.pdf) contains detailed report of the gymnast. Flowchart of the software, which generates Vector-Roadmap, is given in Additional File 3 (http://www.ngds-ku.org/Papers/J48/Additional_File_3.pdf).

At her first checkup on November 22, 2014, LG, female (age 7 *years* 3 *months* 7 *days*), was asked to gain height and mass to achieve the values of 128.52 *cm* and 25.88 *kg*, respectively, on February 22, 2015 as suggested by Growth-and-Obesity Scalar-Roadmap Model (Kamal *et al.*, 2015*a*). At her second checkup on February 28, 2015 (age 7 *years* 5 *months* 23 *days*), she was measured to have a height of 139.92 *cm* and a mass of 25.69 *kg* — mass-put-on target slightly underachieved. Because of rapid gain of height due to gymnastics, she became severely wasted. She was, then, given targets to achieve 143.24 *cm* height and 42.39 *kg* mass on August 28, 2015, again according to the scalar model. Note that the vector model was not proposed till the end of year 2015 (Kamal *et al.*, 2016*a*; *b*). She reported for her third checkup on August 22, 2015 (age 8 *years* 7 *days*), when she was measured as having height 143.51 *cm* and mass 28.21 *kg* — height-pick-up target overachieved, whereas mass-put-on target grossly underachieved. She was, then, given targets to achieve 146.67 *cm* height and 46.92 *kg* mass on February 22, 2016. At her fourth checkup on March 26, 2016, she measured 147.255 *cm* and had a mass of 29.975 *kg*. Height gain was as per advice. However, mass-gain target again very much below the recommendation. LG's dress code 0/0.5 meant she was barefooted and examined completely undressed wearing only panties (Figures 1*a-d*). Behavior code 0 meant she was relaxed and coöperative (Kamal, 2006; Kamal *et al.*, 2002*c*). The parents received lifestyle adjustment, diet and exercise plans to achieve given targets (Table 8*b*).

Growth-and-Obesity Vector-Roadmap of LG depicting her four checkups (age range**:** 7 *years* 3 *months* 7 *days* — 8 *years* 7 *months* 11 *days*) is presented, giving both CDC percentiles

Table 8*b*. Lifestyle adjustment, diet and exercise plans for LG to achieve month-wise targets

	Height Management	*Mass (Weight) Management*
Lifestyle Adjustment	Recommended daily dose of vitamin D (600 IU) through 10-15 minute guarded-graduated[∈] sun-exposure (early morning or late afternoon) with the child minimally dressed (leaving head, arms, legs and spinal column exposed, last one from external auditory meatus to hip joint; eyes protected through UV-cutoff glasses); 1-2 hour fresh air exposure to uncovered skin; hair and body massage with olive oil before bathing; 8-hour, night-time, sound sleep dressed in pajama shorts only[@] (3-minute, slow-stoke back massage to improve quality and quantity of sleep) — before putting to bed (girls') hair unbraided and opened up[⊕], all hair accessories, jewelry, watch, belt removed (for safety reasons); maximum 2-hour screen time (one hour computer/video games — computer monitor at eye level, neck and back straight and normal to thighs; one hour TV/DVD)	
Diet Plans	3 relaxed and balanced meals; 10-12 glasses of water daily — absolutely NO carbonated drinks[&]	
	To gain height, diet plan should include calcium-, protein- and fiber-rich diet (milk, fresh fruit, chicken and fish)	To put on mass (weight), diet plan should include milk, potato items (baked or boiled, but not fried) and protein-rich diet
Exercise Plans	Exercises for 5 minutes each after waking up, at the end of every hour and before going to bed — bending on sides, focusing eyes far away and moving eyeballs, moving fingers and wrists after computer work and writing, stretching, touching toes without flexing knees, exercising neck muscles (left, right, up, down), light exercises during TV/DVD watching. Structured exercises, guarded-graduated[©], preceded by warm-up and followed by cool-down routines, preferably outdoors (weather permitting) in exercise-friendly clothing[ɔ]	
	To pick up height, child should perform light-stretching exercises (bar hanging, mild-stretching, summersault, cartwheel)	To increase mass (weight), heavy exercises performed for shorter duration, consistently

[∈] 'Guarded' implies surveillance of overexposure, which may cause skin burn (short term) and skin cancer (long erm); 'graduated' means systematic increase in exposure for body conditioning (Kamal & Khan, 2015).

[@] Sleeping in day clothes or underwear should be discouraged. In gender-segregated sleeping quarters, boys of all ıges and younger girls should be encouraged to sleep stripped-to-waist, allowing the body to breathe and ncreasing tactile stimulation (Kamal & Khan, 2014).

[⊕] Allowing hair to breathe during night

[&] Carbonated drinks take away body's capacity to absorb calcium and iron and hence should be avoided, *not nly*, by children, *but also*, by persons of all ages, in particular, older individuals.

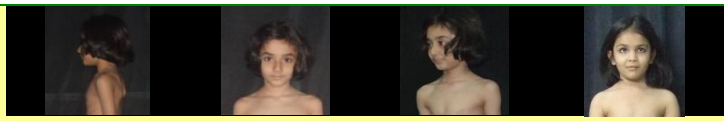
[©] Guarded-graduated exercises should contribute towards health- as well as skill-related fitness (perfor- mance :onsiderations). Such practices, also, avoid exercise-related injuries (safety considerations). 'Guarded' is related o the concept that different body ligaments are in stable equilibrium, locally, during different exercise phases ınd 'graduated' implies that sequential exercise phases are related by infinitesimal transformations (Kamal & Khan, 2013).

[ɔ] Details of exercise-friendly clothing are given in Kamal & Khan (2015).

as well as scaled percentiles of height and mass (Table 8*c*). Algebraic status (pertaining-to-height) was expressed as percentage taking current-age-mid-parental height as reference, positive indica-

Table 8*c*. Growth-and-Obesity Vector-Roadmap of LG

Gender: Female ♀ • *Date of Birth* (*year-month-day*): 2007-08-15 • *Army-Cutoff Height*: 157.48 *cm* (19.36^{P})[¥]
Father's Height: ♂ 167.16 *cm* • *Mother's Height*: ♀ 160.16 *cm* • *Target Height*: 157.16 *cm* (18.14^{P})

Checkup	*1st*	*2nd*	*3rd*	*4th*
Photograph				
Scanned Signatures	$\mathcal{LG}$	$\mathcal{LG}$	$\mathcal{LG}$	$\mathcal{LG}$
Class and Section	II-B	II-B	III-B	III-B
Date of Checkup (*year-month-day*)	2014-11-22	2015-02-28	2015-08-22	2016-03-26
Age (*year-month-day*)	07-03-07	07-05-23	08-00-07	08-07-11
Age (*decimal years*)	7.27	7.54	8.02	8.61
Dress Code	0/0.5	0/0.5	0/0.5	0/0.5
Behavior Code	0	0	0	0
Height, *h* (*cm*)	126.96	139.92	143.51	147.255
Height (*ft-in*)	4 *ft* 1.98 *in*	4 *ft* 7.09 *in*	4 *ft* 8.50 *in*	4 *ft* 9.97 *in*
CDC Percentile-of-Height, $P_{CDC}(h)$	74.37	99.01	99.06	99.06
Scaled Percentile-of-Height, $P_{Scaled}(h)$	82.31	99.42	99.45	99.45
Estimated-Adult Height (*cm*)	167.59	180.04	180.44	180.42
Estimated-Adult Height (*ft–in*)	**5 *ft* 5.98 *in***	**5 *ft* 10.88 *in***	**5 *ft* 11.04 *in***	**5 *ft* 11.03 *in***
CA-MP (Current-Age-Mid-Parental) Height (*cm*)	118.00	119.59	122.25	125.27
Δ Height *w. r. t.* Current-Age-MP Height (*cm*)	+8.96	+20.33	+21.26	+21.99
Algebraic Status (pertaining-to-height), $STATUS_{\pm}(h)$	+7.59%	+17.00%	+17.39%	+17.55%
Qualitative Status (pertaining-to-height)	**1st-Deg Tall**	**2nd-Deg Tall**	**2nd-Deg Tall**	**2nd-Deg Tall**
CA-AC (Current-Age-Army-Cutoff) Height (*cm*)	118.26	119.86	122.53	125.56
Δ Height *w. r. t.* CA-AC Height (*cm*)	+8.70	+20.06	+20.98	+21.70
Reference Height (*cm*)	126.96	139.92	143.51	147.255
CDC Percentile-of-Reference-Height, P_{ref}	74.37	99.01	99.06	99.06
Gross Mass (*kg*)	23.66	25.69	28.21	29.975
Clothing Correction (*kg*)	0	0	0	0
Net Mass, μ (*kg*)	23.66	25.69	28.21[®]	29.975[®]
Net Weight (*lb-oz*)	52 *lb* 2.72 *oz*	56 *lb* 10.34 *oz*	62 *lb* 3.25 *oz*	66 *lb* 1.52 *oz*
CDC Percentile-of-Net-Mass, $P_{CDC}(\mu)$	51.31	61.58	68.54	65.29
Scaled Percentile-of-Net-Mass, $P_{Scaled}(\mu)$	61.72	71.44	77.52[®]	74.73[®]
Estimated-Adult Mass (*kg*)	58.62	61.76	63.88	62.89
Estimated-Adult Weight (*lb–oz*)	129 *lb* 4.04 *oz*	136 *lb* 2.73 *oz*	140 *lb* 13.64 *oz*	138 *lb* 10.62 *oz*
Height-Percentile-based-Optimal Mass, μ_{opt} (*kg*)	26.37	39.12	42.61	46.75
Δ Mass-for-Height (*kg*)	–2.71	–13.43	–14.40	–16.77
Algebraic Status (pertaining-to-mass), $STATUS_{\pm}(\mu)$	–10.28%	–34.33%	–33.80%	–35.88%
Qualitative Status (pertaining-to-mass)	**2nd-Deg Wasted**	**4th-Deg Wasted**	**4th-Deg Wasted**	**4th-Deg Wasted**
Percentile-of-*BMI*-based-Optimal-Mass, $P(\mu_{BMI})$	77.45	91.61	91.84	91.82
BMI-based-Optimal-Mass, μ_{BMI} (*kg*)	27.01	31.88	34.20	37.19
Estimated-Adult *BMI* (kg/m^2)	20.87	19.05	19.62	19.32
Nutritional Status	**Energy-Ch. I**	**Energy-Ch. I**	**Energy-Ch. I**	**Energy-Ch. I**
$P_{Scaled}(h) + P_{Scaled}(\mu)$	144.03	170.86	176.97	174.17
Build	**Medium**	**Big**	**Big**	**Big**

[¥]The superscript P denotes percentile
[®]Pseudo-gain of mass between 3rd and 4th checkups — mass increase from 28.21 *kg* to 29.975 *kg*; scaled percentile dropping from 77.52 to 74.73 (Kamal *et al.*, 2014)

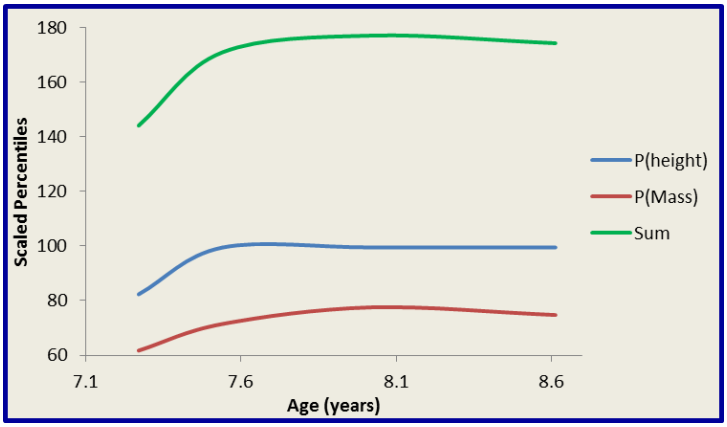


Figure 6. Time evolution of LG's height and mass scaled percentiles as well as their sum for her four checkups in the age range 7.27-8.61 *years*. Note that the gap between height and mass scaled percentiles widened at the second checkup, also indicated by Growth-and-Obesity Vector-Roadmap

ting tallness and negative stunting. Algebraic status (pertaining-to-mass) was expressed as percentage taking optimal mass as reference, positive indicating obesity and negative wasting. Qualitative statuses were assigned from algebraic statuses ($+1\% \leq STATUS_{\pm}(h) < +10\%$ 1st-degree tall; $+10\% \leq STATUS_{\pm}(h) < +20\%$ 2nd-degree tall; $-20\% \leq STATUS_{\pm}(\mu) < -10\%$ 2nd-degree wasted; $STATUS_{\pm}(\mu) < -30\%$ 4th-degree wasted). Figure 6 graphically depicts scaled height and mass percentiles for her four checkups. Height-percentile-based-optimal mass was computed by applying the condition that CDC percentile-of-optimal-mass matches with CDC percentile-of-height. *BMI*-based-optimal mass was computed in 3 steps elaborated in Kamal (2017).

Reports containing information given in Tables 8*a-c* are handed over to each student of gymnastics, whose checkup is conducted. Mother, accompanied by father, is requested to come to school/SF-Growth-and-Imaging Laboratory and discuss the report. We follow 'Disclosure and Regret Model', in which any mistake in report is immediately notified to the parents with regrets, which is adapted from University of Michigan Health System's 'Disclosure, Apology and Offer Model' (Simmons, 2016).

DISCUSSION

There is a dire need to streamline various definitions of childhood obesity (Kamal, 2016) so that one arrives at a mathematical criterion requiring a child to lose net weight within a span of half-a-year (Kamal, 2017). Such a criterion should be validated based on anthropometric data collected locally (Kamal *et al.*, 2017*b*). The power of mathematics (Kamal, 2008) should be employed, *not only*, to generate guidelines to maintain optimal weight-for-height of gymnasts (Kamal, 2015*c*) and prevent spinal injuries (Kruse & Lemmen, 2009), *but also*, to generate builds (Kamal & Khan, 2015) and somatotypes (Raković *et al.*, 2015), so that classroom sections and gymnastic teams could be formed according to build (Kamal, 2015*d*). This may be achieved by following a structured routine of physical and psychological examinations combined with fitness testing to generate 'objective data' (physical findings, Growth-and-Obesity Vector-Roadmaps) along with the 'subjective data' (history — parents, pregnancy, birth, infancy and early childhood as well as the most-recent history, in the physical, the psychological, the academic and the social domains) to chart a course-of-action for the long-term health

protection of a gymnast (Bates, 1991). The importance of medical selection and orientation in gymnastics cannot be overemphasized (Alexescu *et al.*, 2014). It is recommended that the medical orientation of a gymnast should go through the stages of sport medical anamnesis (general anamnesis and gymnastic-specific anamnesis), somatoscopic and somatometric exams (assisted by clinical photographs on which square grids are superimposed, moiré fringe topography, rasterstereography, dotted-rasterstereography) and physical-quality assessment.

3-D movements of gymnasts may be analysed by adapting mathematical framework used in the telemetry techniques for tracking rocket maneuvers as well as robotic-arm control (Kamal, 2015*b*). Hiley & Yeadon (2015) describe optimal technique, variability and control in gymnastics. Gymnastic moves are learnt and refined within constraints on anatomical limits, coördination precision, flexibility and strength as well as mechanical limitations of a given movement. Achieving constant success is of greater importance as compared to some biomechanical measure of movement.

CONCLUSION

This work described fitness testing, psychological and physical examinations of primary-school students participating in gymnastic activities with a focus to generate Growth-and-Obesity Roadmaps, which included statuses (pertaining-to-height) and (pertaining-to-mass), nutritional status, build based on scaled percentiles adjusted for the Pakistani population. In addition, mathematical-statistical definitions of normal, early, delayed, excessively delayed, excessively early and precarious puberty are given and approximate Tanner scores related to various stages of puberty (prepubertal, peripubertal, pubertal, adolescent and adult). Application of these concepts is expected to improve the overall health of young gymnasts in turn contributing to improvement of their performance.

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*Informed Consent and Confidentiality Standards***:** G Family was invited to come to SF-Growth-and-Imaging Laboratory after the Project Director received completed and duly signed (by both parents and the participating child) Informed Consent Form, named as 'The SGPP Participation Form' — page 11 of Additional File 1. To safeguard G Family's privacy, the photographs, included in LG's Growth-and-Obesity Vector-Roadmap and in Figure 1, do not show the actual child, whose profile is presented. In addition, family label (G) and initials of child

(LG) are different from first letters in the actual names (according to our group's confidentiality standards). Same holds for the case numbers appearing in this paper. These are different from the numbers entered in reports given to parents. Further, in place of scanned signatures, initials are given, again, to protect privacy. For school checkups, 'Informed Consent Form', employed opt-in policy — page 5 of Additional File 1.

*Additional Resources***:** *Additional File* 1 (http://www.ngds-ku.org/papers/J48/Additional_File_1.pdf) contains virtual tour of the SF-Growth-and-Imaging Laboratory as well as description of the institutional review process, the NGDS checkups on school premises and the SGPP checkups in the SF Laboratory. *Additional File* 2 (http://www.ngds-ku.org/Papers/J48/Additional_File_2.pdf) contains proposed report of Growth-and-Obesity Vector-Raodmap. At the end of report, summary of history, physical examination and clinical photographs of LG are included. Pages 7-10 give color codes used in report as well as coördinate-plane and Venn-diagrammic representations of nutritional-status classification. *Additional File* 3 compares severity of acute malnutrition computed using CDC and scaled percentiles (http://www.ngds-ku.org/Papers/J48/Additional_File_3.pdf), illustrating the case history of GR, an acutely malnourished child. In addition, assigned build is compared based on CDC and scaled percentiles. Flowchart of the software is placed on page 6.

*Authors' Note***:** Laura Clinton, Physical Education Teacher in East Anglia, England had extensive dialogue with SAK regarding pre-participation and end-of-the-term physical examinations. The software used to generate Growth-and-Obesity Roadmaps was generated by Shakeel Ahmed Ansari, PhD Candidate, Department of Physics, University of Karachi. Thanks are, also, due to Dr. Yasmin Ansar Rizvi, Medical Officer, University-of-Karachi Clinic, for convincing SAK to recommend banning carbonated drinks (*cf.* diet plans for children). No potential conflict of interest is identified for this work.

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Health promotion needs and ICT supported health coaching expectations of white-collars by exercise stages, sex and daily time slots

Hakan Kuru[1], **Mustafa Levent Ince**[1]

[1] Middle East Technical University, Ankara, Turkey

hkuru@metu.edu.tr

Abstract

Identification of health promotion needs may contribute to the development, implementation, design of health promotion programs and healthy lifestyle behaviours. The purpose of this study was to examine white-collars health promotion needs and ICT supported coaching expectations using transtheoretical model in terms of sex, exercise stages of change and daily time slots. A non-experimental mixed method study was conducted with ranking persona cards and face to face semi-structured interviews. Participants were 40 white collars (20 women & 20 men), who were selected from 312 white-collars by stratified random sampling. Participants are equally representing the contemplation, preparation, action and maintenance levels. Mean age of participants was 30.1 years (SD = 3.3). The findings indicated that white-collars health promotion needs and ICT supported coaching expectations differed by sex, exercise stages and daily time slots, and qualitative interview data supported the findings. Consequently, future ICT supported coaching solutions and health promotion specialists should emphasize on white-collars' specific needs and expectations differed by sex, exercise stages of change and daily time slots.

Keywords: Health promotion, physical activity, sex, gender, daily time slots

INTRODUCTION

Health promotion is defined variously but all definitions focus on striving for good health. WHO expressed health promotion as "The process of enabling people to increase control over the determinants of health and thereby improve their health"(WHO, 1986) Similarly, Green & Kreuter defined as "any planned combination of educational, political, regulatory and organizational supports for actions and conditions of living conductive to the health of individuals, group or communities" (Green & Kreuter, 2005). Health promotion aims to change personal characteristics and skills, social norms and actions, organizational practices and public policies that are reasoned to any kind of health promotion activity.

Health promoting behaviours have various definitions, such as "action taken by an individual or group of individuals to change or maintain their health status or prevent illness or injury"(Nutbeam, 1998). Ingledow (1996) explained health behaviours as any action or behaviour considering health(Ingledew, Hardy, Cooper, & Jemal, 1996). Chen identified six major health promoting behaviours for representing wellness dimensions; exercise behaviour, nutrition behaviour, health responsibility, social support, life appreciation and stress management (M.-Y. Chen, Wang, Yang, & Liou, 2000; Moore & Tschannen-Moran, 2010)

Health coaching in other words wellness coaching, aims to provide healthy, sustainable behaviour change. During this change process health coaches leads their clients to develop inner wisdom, identify own values, and challenge for their goals. The science behind health coaching based on the positive psychology, appreciative inquiry, motivational interviewing and goal setting (Engel, 2011; Moore & Tschannen-Moran, 2010).

Health care sector is now in a point where traditional medical approach and disease management issues are being redefined, bringing about a shift from traditional reactive healthcare to proactive and personal health promotion(Swan, 2009). It is not surprising that, with the power of technology, personal health care systems shaped with ICT (communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, as well as the various services and applications associated with them, such as mobile applications). ICT moves health coaching forward to predictive, personalized, preventive and participatory (4P) model(Lupiáñez-Villanueva, Hardey, Torrent, & Ficapal, 2011; Torp, Hanson, Hauge, Ulstein, & Magnusson, 2008; While & Dewsbury, 2011). 4P health care model energized by ICT. However, technology acceptance and costs are challenges to achieving this proactive model.

White-collars have competencies and confidence to use those technologies and have a higher income than other employment groups for covering cost (Christensen & Knezek, 2008; Jaspers, 2009). Within todays' adult population, white-collars, such as accountants, attorneys, engineers, architects and university staff are usually the group of people with better economic potential, competencies and confidence to use ICT. Moreover, white-collars are working in the office settings, that are very vulnerable to inactivity related health problems such as diabetes, obesity, and some form of cancers (Burton, Chen, Schultz, & Edington, 1998; Knox, Biddle, Esliger, Piggin, & Sherar, 2014; O'Donnell, 2001).

The transtheoretical model explains individual's motivational readiness to act a new healthier behaviour and change through stages of change. This model was developed on psychological sciences; social cognitive theory and learning theory(Bandura, 1986). The five stages are pre-contemplation, contemplation, preparation, action and maintenance. This model developed for understanding how

different processes of change can affect the way of process in changing behaviours (Marcus & Simkin, 1994; Prochaska & Velicer, 1997; Redding, Rossi, Rossi, Velicer, & Prochaska, 2000)Individual's thought patterns differs throughout the stages of change. This process begins with consciousness raising. At this stage individual learns new facts or ideas and this encourages to understand the existence of a problem (pre-contemplation). At the second stage, advantages and disadvantages of a possible change were considered and decisions made (contemplation stage). This progresses provides self-reflection and compose a commitment to make a change (preparation stage). This stage followed by active involvement in taking steps to change poor behaviour (action stage). Last stage involves maintaining new habit successfully and avoid any temptations to return to the poor habit (maintenance stage) (Prochaska & Marcus, 1994). Exercise stages of change is a model that assesses level of readiness to participate exercise(Marcus & Owen, 1992). At Stage 1 (pre-contemplation) individual is inactive and not thinking about becoming more active. At Stage 2 (contemplation) individual is inactive and thinking about becoming more active. At Stage 3 (preparation) individual participates some physical activity. At Stage 4 (action) individual participate in recommended amounts of physical activity but have not done so for 6 months. At Stage 5 (maintenance) individual participates physical activity as a habit(Marcus & Forsyth, 2003).

Physical activity and exercise affect many dimensions of health and health promoting behaviours(Health & Services, 1996). Recently, a social cognitive theory based physical activity intervention revealed that enhancing physical activity was effective on developing health promoting behaviours, including health responsibility behaviour, social support, nutrition behaviour, exercise behaviour and stress management (Ince, 2008). In another study, physically active participants are better at health responsibility, spiritual growth, interpersonal relationships, nutrition and stress management.

Accordingly, specific needs and expectations with respect to sex need to be examined as a factor for health promotion programs. Main reason of the distinction about sex can be explained as diversity in health related behaviours (Liang, Shediac-Rizkallah, Celentano, & Rohde, 1999). For example; men drive unsafely, smoke and drink more. Whereas, women take vitamin more often than men, brush more frequently their teeth, seek more medical care and/or self-medication(Waldron, 1988). Conversely, men participate more vigorous physical activity than women do (Yen, 2012).

Activities of daily living are expressed as routine activities need to be completed every day without any assistance. There are two types of daily activities; basic activities and instrumental activities. The basic activities of daily living are self-care tasks. The six basic activities are eating, dressing, bathing, toileting, transferring and continence. The instrumental activities are complex tasks that requires organizational skills and physical performance such as taking medications as prescribed, managing money, using technology (A. B. James, 2014). All of the basic and instrumental activities of daily life occur in different time periods of the day, this leads changes in individual's health promotion activities. (Steckler & Goodman, 1989).

There were studies identifying the health promotion needs of individuals, however none of the studies focused white-collars(Buranatrevedh, 2013; Crawford, Graveling, Cowie, & Dixon, 2010; Olsen & Nesbitt, 2010). Considering these issues, the purpose of this study was to examine white-collars health promotion needs and ICT supported coaching expectations using transtheoretical model in terms of sex, exercise stages of change and daily time slots.

METHODS

Sampling and Participants

In this study, participants were 40 white-collars (20 women and 20 men) who were selected from 312 respondents by stratified random sampling, working on a full-time job at least 5 days a week. Initially, 512 white-collars from universities, public offices and private companies were contacted via e-mail. The contact addresses retrieved from related public office managements and also by colleagues who were working in the same workplaces. 64% (n=326) of the contacted participants responded and fill the web-based Physical Activity Stages of Change Questionnaire (PASCQ).

Stratified random sampling method procedure was followed as: strata were constructed on exercise stages of change. Later, five women and five men from each stage drawn from each stratum randomly. Participants in pre-contemplation stage were not included in study, because of no intention to participate in exercise in the future (Marcus 2009).

The participants have a mean age of 30.1 years (SD = 3.3). Mean age of women and men participants were 30.7 years (SD = 3.5) and 29.5 years (SD = 3.2) respectively. According to exercise stages mean age for contemplation (Stage 2) was 30.4 (SD=3.3), preparation (Stage 3) was 29.5 (SD=2.6), action (Stage 4) was 30.9 (SD=3.8) and maintenance (Stage 5) was 29.6 (SD=3.7). None of the participants had a physical inability to participate exercise.

Study Design

Non-experimental mixed method design was used in this study. Design included two consecutive phases. In the first phase, a survey conducted for examining the demographic characteristics and exercise stages of change of participants for applying stratified random sampling. In the second phase semi-structured interviews accomplished with sample of 40 white-collars.

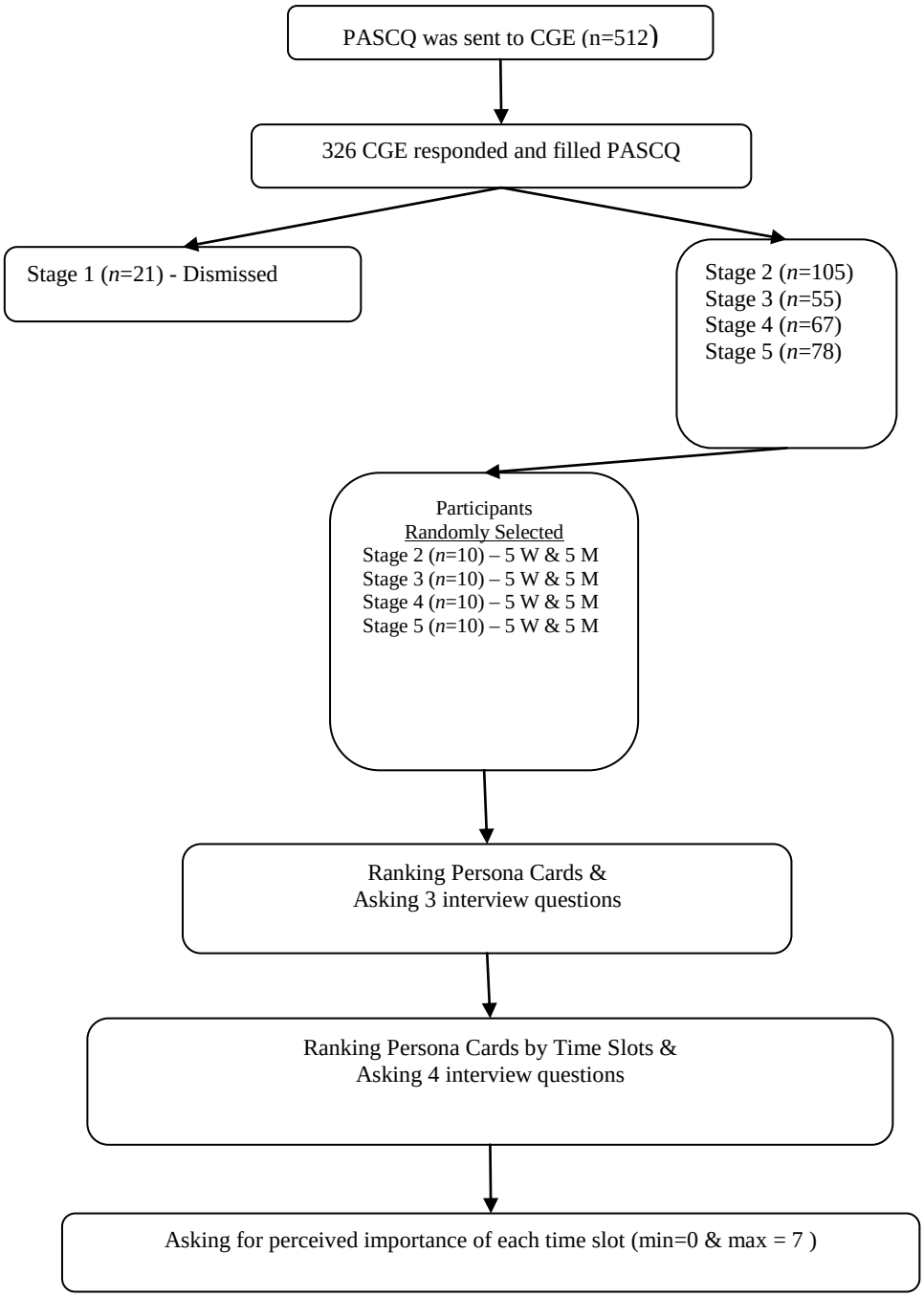

Figure 1. Design of the study

Abbreviations
PASCQ: Physical activity stages of change questionnaire
CGE: College graduate employees
W: Women
M: Men

Measures

Stages of Change. In order to identify the exercise stages of change of participants Physical Activity Stages of Change Questionnaire (PASCQ) applied(Marcus & Owen, 1992). PASCQ measures

individual's motivational readiness for physical activity. In the questionnaire, four questions are asked to assess participants exercise stage of change by a binary type of scale (yes/no). According to answers, participants are classified on five different motivational stages including pre-contemplation (no intention to participate in physical activity), contemplation (have intention to participate in physical activity but does not participate), preparation (has just started to regular physical activity), action (participate in physical activity regularly longer than one month, less than six months) and maintenance (participate in physical activity regularly more than six months). The original scale is in English (Marcus & Owen, 1992). A validated version of the scale submitted in this study (Cengiz, İnce, & Çiçek, 2009).

Importance of Health Promoting Behaviours. For measuring perceived importance of health promoting behaviours persona cards were prepared for representation. Six health promoting behaviours were exercise behaviour, nutrition behaviour, health responsibility, social support, life appreciation and stress management(M. Chen, Wang, Yang, & Liou, 2003). The six health promoting behaviours were the six persona cards were wellness dimensions and a previously prepared health promoting behaviour scale by Chen (M. Chen et al., 2003; Roscoe, 2009).

A group of experts (total of five experts) in health promotion and physical activity (two experts), nutrition (one expert), and design (two experts) examined the health promoting behaviours. Researcher and one designer prepared the initial form of the persona cards which are depicting each health promoting behaviour. Finally, persona cards assessed by the above mentioned five experts and final forms were fixed by mutual agreement.

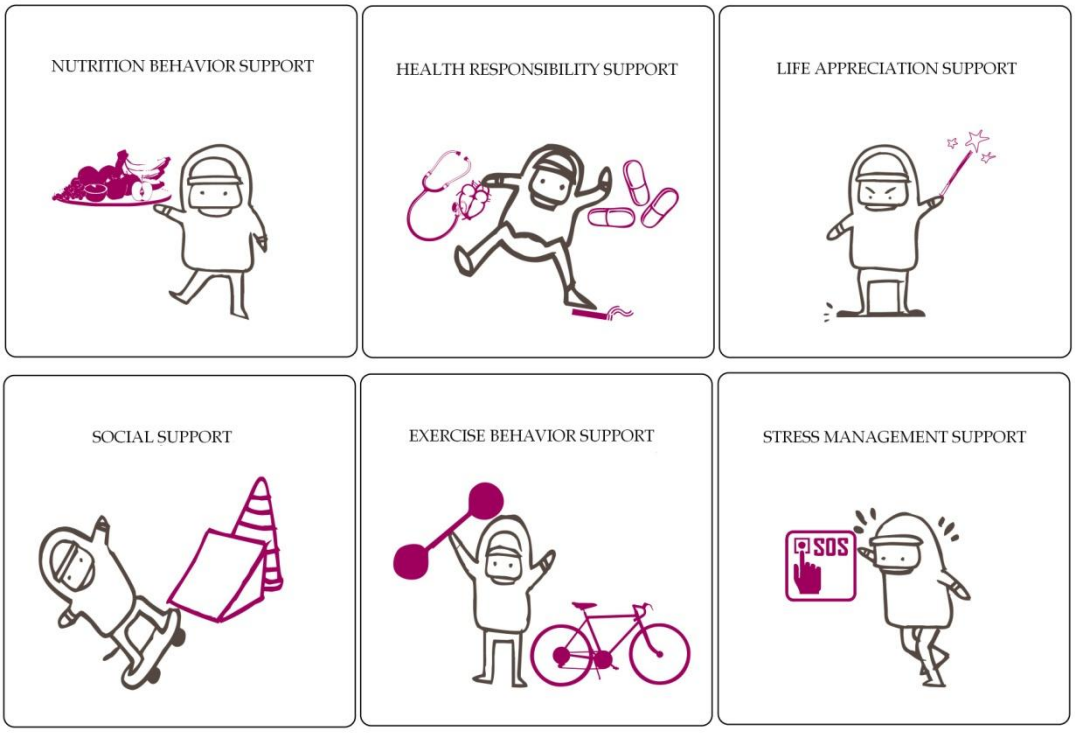

Figure 2. Persona cards representing six health promoting behaviors

Health Promotion Needs and Health Coaching Expectations. For examining health promotion needs and health coaching expectations semi-structured interviews conducted in two consecutive parts. In the first part of the interview, researcher asked three questions to participants about;

1) Rationale behind his/her persona card rankings,

2) Examples of problems that you faced about each health promoting behaviour,

3) ICT-based health coaching expectations for each problem mentioned.

In the second part of the interview, researcher asked four questions to participants for each time slots;

1) Health promotion needs for each health promoting behaviour,

2) Examples of problems about health promoting behaviours,

3) ICT-based health coaching expectations for each problem mentioned,

4) Preferred methods of ICT-based health coaching for each given time slots.

Importance of Daily Time Slots for Health Coaching. During the interview on daily time slots, participants scored each time slot on a 0 to 7 scale according to perceived importance for health coaching.

Procedures

Before the study, Middle East Technical University Human Ethics Committee granted ethical approval. In the first phase of the study, sampling process completed and identification of demographics completed. In the second phase of the study, semi-structured interview conducted. During the interview, participants firstly ranked six cards (persona cards) which were representing one of the six health promoting behaviours [Exercise Behaviour (EB), Nutrition Behaviour (NB), Health Responsibility Support (HR), Social Support (SS), Life Appreciation Support (LA) and Stress Management Support (SM)] according to perceived importance. Later, researcher interviewed for understanding rationale of ranking, problems about each health promoting behaviour and coaching expectations.

Afterwards, participants again ranked persona cards for each of 8-time slots [duration between waking-up and leaving home (T1), duration of transportation to work (T2), duration at work (T3), duration of lunch break (T4), duration of transportation to home (T5), duration at home before going bed (T6), duration of sleeping (T7), duration of non-routine days (T8)]. At this process, researcher interviewed for each time slots ranking on health promotion needs and health coaching expectations.

Data Analysis

Quantitative data analysed by descriptive statistics. Afterwards, Mann-Whitney U and Friedman test applied for perceived importance of health promoting behaviours. In descriptive analysis procedure, results of persona card ranking were analysed by recoding the ranking scores. In this method, 1st ranked behaviour was equal to 6 point and the last behaviour (the 6th) was equal to 1 point. Finally, the total points were calculated, and the results of total scores were ranged from 0 to 240. In addition, the importance of each daily time slot calculated using importance scores with a minimum value of 0 and maximum value of 7.

Qualitative data analysed using content analysis method (Creswell, 2013). After transcription of voice records, categories developed on the basis of research questions. After examining qualitative data, glossary of terms created. In glossary of terms was constructed for assisting advocates in understanding commonly used terms for coding the statements under same term. For the trustworthiness, two independent coders provided glossary of terms. After, agreement on the conflicts researcher analysed the data. Intra-coder agreement in two month time span was .96. Qualitative data collected in the study handled for supporting the quantitative findings.

RESULTS

Sex

According to Mann-Whitney U test results, men's health promotion needs (*Mdn*=15.00) on health responsibility behaviour (HRB) was significantly more important than women's HRB (*Mdn*=25.00), *U*=106.50, *z*=-2.60, *p*<.05, *r*=.41. The qualitative data enlightened that participants needs on HRB for preventing and promoting health status and changing health responsibility behaviours for both women and men. The problems about preventing health status were inability to change poor health responsibility behaviours and lack to awareness about health responsibility behaviours. The explained expectations clustered around personal check-up system by a mobile device but they only wanted to use this system at home, considering their privacy for women. On the other hand, men preferred to monitor vital signals by wearable device and they preferred to use it every time and everywhere.

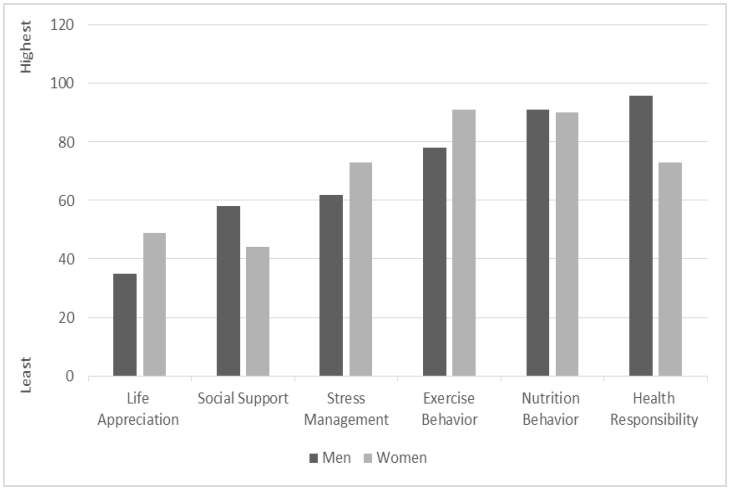

Figure 3. Importance of Health Promoting Behaviours by Sex
(minimum possible score: 0, maximum possible score: 120)

The second explanation about need on HRB was promoting health status. Participants described two major problems about promoting health status; lack of motivation for changing behaviours and lack of awareness about health responsibility behaviours. However, expectations differ; women preferred report of vital signals, log of menstrual cycle, medical tips on a visual platform especially from personal computer at work. Men suggested solutions about reaching information about health responsibility behaviours such as; health responsibility tips and reminder from a mobile platform in an intrusive way.

The third explanation about need on HRB was changing health responsibility behaviours. The mentioned problems about changing health responsibility behaviours were again lack of motivation and lack of awareness about health responsibility behaviours. Women and men preferences differed

about these problems solution. Women preferred visual stimulus about unhealthy behaviours such as nutritional information on credit card bill or barcode, on the other hand men preferred personal health responsibility tips by an application or audio tips while driving car.

Exercise Stages of Change

Health promoting needs were significantly differed by exercise stages of change $H(3) = 7.82$, $p < .05$. Mann-Whitney test applied for follow up this finding. Findings indicated that Stage 3 (preparation) participants' needs on stress management (SM) were significantly more important than Stage 2 (contemplation) participants' needs (U=104, r=-.17). The qualitative results revealed that Stage 2 and Stage 3 participants both have problem of coping with stress. The related problems were having no control on managing stress level and solving daily problems. Stage 2 participants expected an invisible stress management coaching, which detect level of stress and applies needed operation, custom relaxing stimulus and time and coaching work plan for daily duties. However, participants at Stage 3 suggested to be assisted on preparing time and work plan for daily duties and get a coaching support on exercise and nutrition behaviours.

Daily Time Slots

In this part, the results of importance scores for each time slots (0 to 7) were presented. The results showed that the most important time slots for ICT supported health coaching was duration of non-routine days-weekends, holidays (T8). Duration at home before going bed (T6) was the 2nd time slot and duration at work (T3) was the 3rd time slot according to the total scores for importance. In the 4th place duration of lunch break (T4) was ranked. Afterwards, duration between waking-up and leaving home (T1) was at 5th place, duration of transportation to home (T5) was 6th, duration of transport to work (T6) was 7th and duration of sleeping (T7) was the 8th on the ranking (Figure 4).

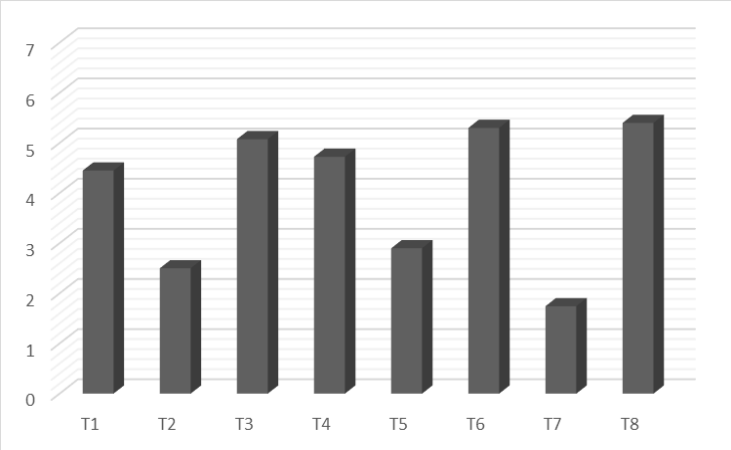

Figure 4. Perceived Importance scores for Daily Time Slots
(each participant gave a score between 0 and 7. 0 indicates least importance and 7 indicates highest importance)

T1 - duration between waking-up and leaving home

T2 - duration of transportation to work

T3 - duration at work

T4 - duration of lunch break

T5 - duration of transportation to home

T6 - duration at home before going bed

T7 - duration of sleeping

T8 - duration of non-routine days

In order to understand the relation between health promotion needs in terms of daily time slots, Friedman test was conducted. The results showed that health promoting needs were significantly differed for nutrition behaviour ($X^2(6)=.00$, $p<.05$), exercise behaviour ($X^2(6)=.001$, $p<.05$), health responsibility ($X^2(6)=.00$, $p<.05$), life appreciation ($X^2(6)=.045$, $p<.05$), social support ($X^2(6)=.00$, $p<.05$) and stress management ($X^2(6)=.00$, $p<.05$) with respect to each time slot. In other words, needs all health promoting behaviours significantly differ at all daily time slots (Figure 5).

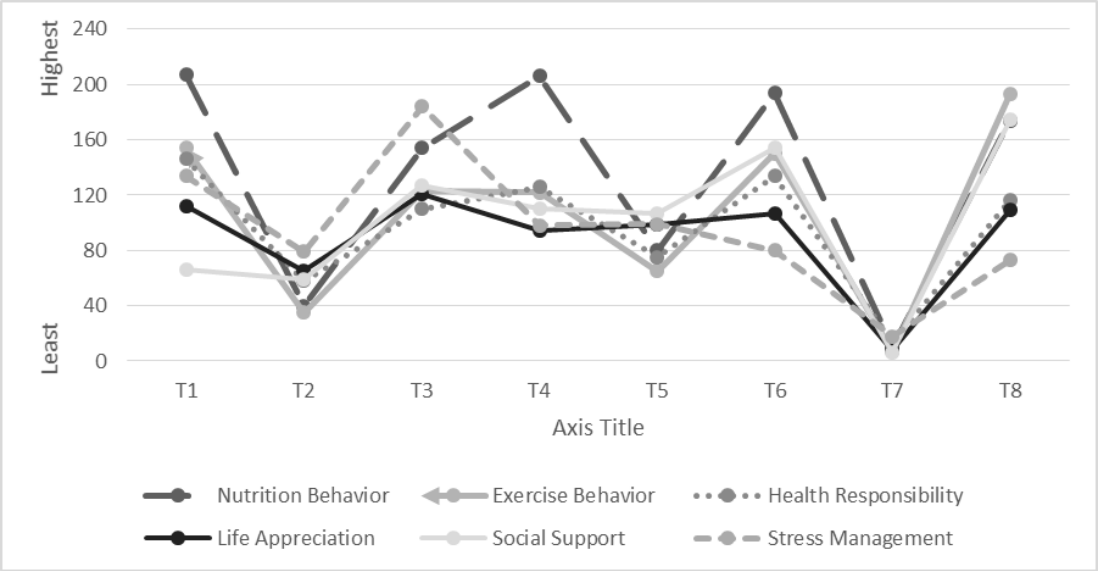

Figure 5. ICT supported Health Promoting Behavior Coaching Needs of CGEs' by daily time slots (minimum possible score: 0, maximum possible score: 240)

T1 - duration between waking-up and leaving home

T2 - duration of transportation to work

T3 - duration at work

T4 - duration of lunch break

T5 - duration of transportation to home

T6 - duration at home before going bed

T7 - duration of sleeping

T8 - duration of non-routine days

T8 - Duration of Non-routine Days

The results indicated that duration of non-routine days (T8) was the most expected time slot for ICT supported health coaching. In this time slot, participants ranked importance of health promotion needs as; exercise behaviour was the 1st, social support was the 2nd, nutrition behaviour was 3rd, health responsibility was the 4th, life appreciation was the 5th and stress management was the 6th.

According to interview data results, participants desired to be physically active on non-working days. However, in this time slot, participants faced with two major problems; lack of motivation and lack of awareness on nutrition behaviours. Participants expected to be motivated by socialization and get suggestions on physical activity for being motivated by ICT supported health coaching. ICT supported health coaching should provide personal workouts, tips on exercise and coaching during exercise time. Most preferred ways of interaction in his time slot were visual and audio stimulus but should be intrusive. Another explained health promotion need at this time slot was about eating healthier. The problem on this behaviour is having difficulties on limiting calorie intake on these days. Participants explained the barrier as lack of awareness on nutrition behaviours. Participants clarified expectations as getting tips on nutrition and a smart prescriptive plan, which can be adaptable for daily conditions. The preferred way of interaction with ICT supported health coach was visual stimulus via smartphone.

T6 - Duration at Home Before Going Bed

The time spent at home before going bed was the 2nd most important time slot. In this time slot, participants ranked health promoting behaviours as; nutrition behaviour as the 1st, social support as the 2nd, exercise behaviour as the 3rd, health responsibility as the 4th, life appreciation as the 5th and stress management as the 6th.

The interview findings revealed that nutrition behaviour is more important since participants desire to have healthier diet. The main problem faced was lack of understand personal nutritional needs. Participants' expectations shaped on getting prescriptive menu for dinner and getting nutrition tips. The preferred way of interaction was clustered around on a visual interaction by smartphone.

T3 - Duration at Work

The time spend at work was the 3rd most important time slot for participants for being supported by ICT supported health coaching. The importance of health promoting behaviours in this time slot ranked as: stress management as the 1st, nutrition behaviour as the 2nd, social support as 3rd, exercise behaviour as the 4th, life appreciation as 5th and health responsibility as 6th.

The qualitative data enlightened that participants needs on stress management behaviour, since they felt stressful at work. Participants had difficulties on coping with stress, expected to be coached about managing stress. Participants preferred to be supported by relaxing audio stimulus from office computers or smartphone.

DISCUSSION

Sex

Findings on health promotion needs in terms of sex indicated that health promotion needs for exercise behaviour was the most important for women, and health responsibility was for men. Nutrition behaviour is the 2nd most important behaviour for both sex. Reasons behind rankings were similar both

sex, women considered body weight management, knowledge health promoting behaviours, and poor motivation for exercise. Similarly, men stated reasons were same with women, however, men did not consider body weight management. In earlier studies, Davis and Cowles stated that women motivated by aesthetical concerns rather than health related issues in wellness. James also found that men were significantly satisfied with their current weight than the women even they (men) were overweight. Current study findings support the relevant literature (Davis & Cowles, 1991; James, 2003)Sex related studies on health promoting behaviours indicated higher health responsibility behaviours in women as compared to the men (Verbrugge, 1985; Waldron, 1988). Studies also indicated that men have higher exercise participation than the women (Azevedo et al., 2007; Lee, 2005). The findings of this study did not represent the same pattern. This shows that white-collars health promotion needs differ from other employment groups, supports the significance of the study.

ICT supported coaching expectations were providing visual messages, instant coaching during the workouts/daily activities, and workout/nutritional prescriptions. Women emphasized visual messages and workout/nutritional prescriptions. Men focused more on instant coaching during the workouts/daily activities. Both sex expected having medical check-up and tracking of vital signs about health responsibility. However, women preferred to get it support only at home by stressing on personal privacy. These findings were also similar to the designing suggestions in different studies(Neter & Brainin, 2012; Wilkowska, Gaul, & Ziefle, 2010).

Exercise Stages of Change

According to the findings, health responsibility and nutrition for Stage 2, NBS for Stage 3, EBS and HRS for the Stage 4 and NBS and EBS for Stage 5 were the most important health promoting behaviours. The results showed that in all stages participants desire to have prevention and promotion in health status by changing health responsibility behaviours. However, only at Stage 4 and Stage 5, participants feel comfortable about health responsibility behaviours. This can be interpreted as association between level of exercise and health promoting behaviours (Blair, Jacobs Jr, & Powell, 1985). Participants of these stages have higher participation in exercise and perform better health promotion behaviours than lower stages (Cardinal, 1995; Laforge et al., 1999; McAuley & Courneya, 1993).

On expectations from ICT supported health coaching, participants (Stage 4 & Stage 5) suggested that a mobile primary prevention support is a good solution. According to literature, exercise and health status have a positive correlation, so that, individuals at Stage 4 and Stage 5 have better health status than lower stages and less need on health responsibility(İnce & Ebem, 2009).

Participants at Stage 2 and Stage 5, expected to gain knowledge about nutrition behaviour. Although, during the interviews Stage 2 participants explained that they need to get knowledge on the basics of nutrition. On the other hand, Stage 5 participants' expectations are related with physical performance. However, the findings did not have any association with literature, the literature showed no significant association between physical activity and knowledge about nutrition. (Gürel, Gemalmaz, & Dişçigil, 2004).

The results showed that Stage 2 and Stage 3 participants need to be coached for exercise on a motivational perspective. However, Stage 4 and Stage 5 participants did not want to be supported about motivation, they mostly focused on gaining knowledge about exercise. The differentiation in motivational needs can be explained by trans-theoretical model; in the lower stages, a more powerful motivation is needed for changing exercise behaviours, on the other hand, in the higher stages instead

of behaviour change maintenance is fixed (Fallon, Hausenblas, & Nigg, 2005; Laforge et al., 1999; Woods, Mutrie, & Scott, 2002).

Daily Time Slots

Findings on time slots indicated that T8, T6 and T3 were the most critical time slots for ICT supported health coaching. Participants consider exercise and nutrition behaviours at T8, nutrition at T6, and stress management at T3.

At T8, individuals are on their non-routine day and mostly this time slot means as weekend or holiday. In these type of days, a significant change in nutrition and exercise behaviours are observed(Davison, Tsujimoto, & Glaros, 1973; Heimendinger & Van Duyn, 1995). Participants majorly preferred to be supported by EB, SS and NB at T8, in order to control sharp changes in their behaviours.

At T6, individuals are just arrived home and spend their time on themselves. This duration is main meal time. On contrast to breakfast and lunch, individuals pay more attention for dinner and have a chance to spend more time for preparation and eating (Ramey & Juliusson, 1998). Accordingly, participants explained the importance of dinner and NB that they have better chance to prepare a home-made meal and they can prepare the meal according to their nutritional needs.

Finally, since T3 is the time duration spend at work, the level of stress increases hopefully. Recent studies showed that, different causes of work-related stress were listed; long hours, heavy workload, tight deadlines, lack of autonomy, inadequate working environment (Firth-Cozens & Payne, 1999; Ganster & Schaubroeck, 1991). According to interviews, time and work plan is one of the major solutions for work-related stress. Individuals need assistance for their workplace and daily duties and planning is a good way to cope with stress. Literature showed that developing a plan is an effective tackle for work related stress (Eerde, 2003; Ivancevich & Matteson, 1980).

CONCLUSION

According to the findings of the study, white-collars' health promotion needs differ by sex, exercise stages and daily time slots. The results showed that physical health was more important, since NB, HR and EB have ranked mostly in the 1st, 2nd and 3rd place. With the findings, ICT supported health coaching should be primarily focused on HR, EB and NB. In addition, the results showed that, ICT supported coaching have to be predictive and preventive; change an undesired behaviour, situation or habit; manage a situation, participate or promote a desirable behaviour or situation. The problems and design solutions differ generally. Women preferred permanent and specific solutions about a situation or habits, however, men prefer instant and temporary solutions that affect their habits in a short period especially on health responsibilities.

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Weight Bearing Ankle Dorsiflexıon Range of Motion Correlates with Dynamic Balance in Volleyball Players with Chronic Ankle Instability

Gulcan Harput[1], Taha Ibrahim Yildiz[1], Filiz Colakoglu[2], Gul Baltaci[3]

[1] Hacettepe University, Faculty of Health Sciences, Department of Physical Therapy and Rehabilitation, Ankara, Turkey.
[2] Gazi University, Faculty of Sports Sciences, department of Physical Education and Sport Teacher, Ankara, Turkey.
[3] Private Ankara Guven Hospital, Department of Physiotherapy and Rehabilitation, Ankara, Turkey.

aktasgulcan@gmail.com

Abstract

The aim of this study was to investigate the relationship between weight bearing ankle dorsiflexion range of motion (ROM) and dynamic balance in volleyball players with chronic ankle instability. Thirty-five female volleyball athletes were included in the study. Dynamic balance was evaluated by star excursion balance test with anterior, posteromedial and posterolateral reach distances. Weight bearing lunge test was used to measure ankle dorsiflexion ROM. Spearman correlation test was conducted for statistical analysis. There were significant correlation between ankle dorsiflexion ROM and SEBT anterior ($p=0.006$) and posteromedial reach ($p=0.009$) distances in injured ankle. Posterolateral reach of SEBT was not correlated with ankle dorsiflexion ROM ($p>0.05$). Deficits in ankle dorsiflexion ROM due to chronic ankle instability may be responsible for decreased balance performance in volleyball athletes.

Keywords: Ankle joint, sprain, star excursion balance test, adolescent, volleyball

INTRODUCTION

Lateral ankle sprain (LAS) is one of the most common sport injuries which constitutes % 15 to % 45 of all sport injuries (Ferran and Maffulli, 2006; Malliaropoulos et al., 2009). Sports involving jumping, landing and cutting maneuvers such as volleyball and basketball are at greater risk due to injury mechanism (Thacker et al., 1999; Wright et al., 2000). Lateral cutting maneuvers are very frequent in volleyball. During cutting movements, a large supination torque that moves the foot inward excessively, overloading and damaging the lateral ankle ligaments. Although LAS is usually considered as an innocuous injury, some of athletes have to stop their career since repetitive LAS causes ankle instability and serious ankle cartilage problem (Verhagen et al., 1995).

Repetitive frequencies of ankle sprains defined as chronic ankle instability (CAI) which is characterized by unstable ankle joint and 'giving-way' feeling (Freeman et al., 1965). Decreased neuromuscular control (functional instability) and lack of ligamentous support (mechanical instability) are main contributors of CAI (Hertel, 2002). Cartilage defects (Valderrabano et al. 2006), lack of postural control (Hertel, 2008, Hoch et al., 2012), muscle weakness (Friel et al., 2006; Arnold et al., 2009) and decreased dorsiflexion range of motion (ROM) (Hoch et al., 2012) are the most common problems showing up with CAI. Athletic performance are also affected by decreased dorsiflexion ROM and altered neuromuscular control (Fong et al., 2011; Basnett et al., 2013). Reduced knee flexion and increased varus and valgus displacements are occurs during squatting and landing with limited dorsiflexion (Fong et al., 2011; Dill et al., 2014).

Star Excursion Balance Test (SEBT) is one of the most common test batteries to assess dynamic balance of single limb while opposite limb reaching as far as possible in a predetermined direction (Gribble and Hertel, 2003). Greater reach distances indicates better dynamic balances and people with CAI shown to have lower reach distances compared to asymptomatic persons (Hertel et al., 2006; Hoch et al., 2012). Deficits in dorsiflexion ROM was shown to decrease anterior reach direction of SEBT (Fong et al., 2011; Hoch et al., 2011; Hoch et al., 2012; Basnett et al., 2013). Although there are studies investigating the effects of dorsiflexion ROM on balance (Olmsted et al., 2002; Hoch et al., 2011; Hoch et al., 2012; Basnett et al., 2013), current knowledge about the relationship between CAI and dynamic balance is inadequate in volleyball athletes.

The aim of the study was to investigate the relationship between weight bearing ankle dorsiflexion ROM and dynamic balance in volleyball players. It was hypothesized that decreased dorsiflexion ROM would be positively correlated with dynamic balance in volleyball players with CAI.

METHODS

Subjects

Thirty-five volleyball players (age: 14.5±1.2 years, height: 170.5±5.5 cm, body mass: 59.3±6.8 kg, time participating in sports activity: 5.3±1.4 h/wk, experience in sport: 4.1±1.8 years) with CAI volunteered to the study. All participants reported a history of at least one ankle sprain and repetitive episodes of 'giving way' feeling on the same ankle. Participants who had a history of ankle surgery, other lower extremity injuries for the last six months and diagnosed ankle joint osteoarthritis were excluded from the study. To avoid acute symptoms of the injury, participants who had ankle sprain for the past 2 months were also excluded from the study. This study was approved by the Ethics Committee of Hacettepe University.

Data collection

Weight bearing ankle dorsiflexion range of motion measurement: Ankle dorsiflexion ROM was measured with weight bearing lunge test (WBLT). It is reliable measurement for ankle dorsiflexion ROM by assessing the anterior displacement of tibia over the talus during weight bearing position (Bennell et al., 1998; Denegar et al., 2002). During testing procedure, participants were in standing position in barefoot and facing the wall. The tested foot was on the front on a tape while other foot was positioned approximately 1 foot behind the tested foot and the knees were perpendicular to the wall. Participants allowed to place their hand to the wall to maintain their balance. In this position participant were instructed to perform lunge and try to reach the wall with the tested extremity's knee while protecting the ground contact with the heel. When the participants able to perform the knee touch without heel rise, the extremity progressed 1 centimeter away from the wall and test was performed again. The test was repeated until the heel contact could no longer be maintained. After this point with small adjustments the maximum distance between the big toe and the wall was measured while maintaining heel contact (Bennell et al., 1998; Hoch et al., 2012). Tree trials were performed and average of trials was recorded (Figure 1).

Figure 1. Weight bearing lunge test

Dynamic balance measurement: Anterior, posteromedial and posterolateral direction of the SEBT were used to assess the dynamic balance following Hertel et al.s' (2010) recommendations. Participants were instructed to stand in the middle of the grid with tapelines extending out 100 centimeters. The angle between anterior (ANT) and posteromedial (PM) or posterolateral (PL) directions was set at 135˚, and between PM and PL was set at 90˚. The participants were instructed to reach as far as possible along each of the three lines, make a light toe-touch on the line without shifting weight, and return to the center of the grid whilst maintaining single-leg balance. Measurements were taken from the most distal aspect of the toes. Three practice trials were given for each limb for each direction. The participants then performed three trials in the three directions for each limb. The average of the three reach distances was recorded (Gribble and Hertel, 2003; Hertel et al., 2010) (Figure 2).

Figure 2. Star excursion balance test anterior reach

Data analysis

SPSS version of 22.0 was used for statistical analysis. Spearman correlation analysis was performed to determine the relationship between ankle dorsiflexion ROM and SEBT anterior, posteromedial and posterolateral directions. The relationships were interpreted as; little or no relationship (r = 0.0-0.25), fair relationship (r = 0.25-0.50), moderate to good relationship (0.50-0.75), good to excellent relationship (r > 0.75)(Portney and Watkins, 2015). Statistical significance was set at $p<0.05$.

RESULTS

Descriptive statistics for weight bearing lunge test and star excursion balance test outcomes were shown in Table 1.

Table 1. Mean± SD for SEBT and ankle dorsiflexion range of motion for involved and uninvolved ankle.

	SEBT Anterior (cm)	SEBT Posteromedial (cm)	SEBT Posterolateral (cm)	Dorsiflexion ROM (cm)
Uninvolved	67.6±4.5	83.0±7.3	77.4±8.0	12.6±2.2
Involved	65.3±4.8	78.3±8.5	74.4±7.0	10.2±2.1
p value	0.04*	0.02*	0.09	<0.001*

* Shows significant difference between involved and uninvolved sides ($p<0.05$)

The correlation between weight bearing lunge test and dynamic balance test was found significant ($p<0.05$). Dorsiflexion ROM of the involved side positively correlated with SEBT anterior and posterior reach directions while uninvolved sides' dorsiflexion ROM was only positively correlated with SEBT anterior reach directions (Table 2).

Table 2. Correlation between ankle dorsiflexion and Star excursion balance test outcomes

	SEBT Anterior	SEBT Posteromedial	SEBT Posterolateral
Involved Dorsiflexion ROM	p=0.006* r=0.51	p=0.009* r=0.44	p=0.19 r=0.27
Uninvolved Dorsiflexion ROM	p=0.03* r=0.38	p=0.22 r=0.28	p=0.58 r=0.09

DISCUSSION

The purpose of this study was to determine the relationship between a weight-bearing measure of ankle dorsiflexion ROM and dynamic balance measured using the SEBT in volleyball athletes with chronic ankle instability. The results indicate that there was a significant positive relationship between ankle dorsiflexion ROM and dynamic balance outcomes in these athletes. Ankle dorsiflexion ROM of the injured side correlated with the anterior and posteromedial reach directions of the SEBT that suggests deficits in ankle motion could affect the dynamic performance during a balance task.

Previous studies observed that individuals with chronic ankle instability had a deficits in ankle dorsiflexion ROM and anterior reach of SEBT (Arnold et al., 2009; Hoch et al., 2012; Basnett et al., 2013). Hoch et al., (2012) found a moderate correlation between ankle dorsiflexion ROM and the anterior reach component of the SEBT, while they observed no correlation between ankle dorsiflexion ROM and, posteromedial and posterolateral directions in individuals with chronic ankle instability and healthy control. As the nature of SEBT reach directions, ankle dorsiflexion ROM is more required in anterior reach compared to posteromedial and posterolateral reach directions (Terada et al., 2014; Gabriner et al., 2015) since this direction is performed on sagittal plane movement. Hoch et al., (2011) reported a positive correlation between the WBLT and anterior reach distance in healthy individuals. The current study identified a similar relationship between the WBLT and anterior reach of SEBT also in uninvolved ankle. Anterior reach of SEBT is performed in sagittal plane unlike posteromedial and posterolateral reaches.

Gabriner et al., (2015) postulated that anterior reach of SEBT might be more affected by mechanical restrictions while posteromedial and posterolateral reaches relied more on muscular strength and postural control. Contrary to previous findings, we found a significant correlation between ankle dorsiflexion ROM and posteromedial direction of SEBT only in injured ankle so we suggested that posteromedial reach of SEBT might be also influenced by deficits of ankle dorsiflexion. The decrease in ankle dorsiflexion was shown to affect squat and step biomechanics, postural control and it was thought to increase knee and lower extremity joint pathologies (Fong et al., 2011; Macrum et al., 2012). Therefore, restriction of dorsiflexion motion might affect the neuromuscular control of the lower extremity which cause a decrease in posteromedial reach of the participants in present study.

There were some limitations of the study. We could only include female athletes in the study so the results of the study might not reflect the male counterparts. As we could not objectively monitor the proximal joint during SEBT, we could not suggest that the decreased ankle dorsiflexion was the primary contributor factor to cause a decrease in anterior and posteromedial reaches of SEBT.

CONCLUSIONS

As a result, weight bearing ankle dorsiflexion ROM of injured and health ankles positively correlated with anterior and posterolateral reach directions of SEBT in volleyball athletes with CAI. Those with CAI showed less dorsiflexion ROM on the weight bearing lunge test and shorter anterior reach distance in SEBT. Therefore, deficits in ankle dorsiflexion ROM due to chronic ankle instability may be responsible for decreased balance performance in volleyball athletes. Joint mobilization techniques or taping applications which may increase ankle dorsiflexion ROM could help volleyball athletes to enhance their dynamic balance.

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A Comparison of Match Analysis in Soccer within the Context of Offside Rule Revision

Mehmet Ismet Tok[1], Mert Tunar[1], Caner Cetinkaya[1], Pinar Tatlibal[1], Muammer Kayatekin[2], Atalay Arkan[1]

[1] Dokuz Eylul University, School of Sport Sciences and Technology, Izmir, Turkey.
[2] Dokuz Eylul University, Medical School, Department of Physiology, Izmir, Turkey.

ismet.meh@gmail.com

Abstract

The purpose of this study is to evaluate the effect of a revised offside rule on the activity profile of players and the technical technical actions compared with matches played using the regular offside rule. A home/away league was established for the purpose of this study. For every home/away match, one game was played using the regular offside rule and other was played using the revised offside rule. The distance covered by 82 players during the games was measured by GPS. A computerized match analysis program was used for the notational analyses. A computerized match analysis program was used for the notational analyses. The total distance (8938.2 m; 8480.8 m; respectively), walking (4538.6; 4327.5; respectively), jogging (2328.4; 2224.2; respectively), moderate (1314.7; 1215.1; respectively) and high-speeds (515.2; 455.9; respectively) by players were significantly greater in competitions using the revised offside rule than in games using the regular offside rule. The number of short passes and dribbling were higher in competitions using the revised offside rule, whereas the number of long passes and offside calls were significantly decreased. Total distance covered in the matches played with the Revised Offside Rules was significantly greater than in matches played with the regular offside rule.

Keywords: Match distance covered, offside, notational analysis

INTRODUCTION

The “offside rule”, implemented in 1925, has been controversial in football since its inception (Maurenda, 2004). The offside rule is presently defined in “Laws of the Game” (FIFA, 2013) player nearer to his opponents’ goal line than both the ball and the second-last opponent. In such an instance, the offside rule becomes active and the referee stops the game.

In 2010, FIFA president Sepp Blatter, has been declared to press that it is necessary to make radical changes in offside rule (Wilson, 2010). In fact, Blatter intends to remove offside rule entirely. However, abiding by the offside rule requires high levels of attention, concentration, and the ability to make the right decision, both for the player who is passing and for the player who is receiving the pass. Since the offside rule applies only for one half of the pitch, the defenders of the attacking team take position close to the mid-field line to limit the field of play and to give support to the offense. The result is that more players spend time positioned in the middle of the field. In modern soccer, the active playing field has shrunk due to the increased physical abilities of the players and more highly developed defensive techniques. For these reasons, it might be considered that making a revision for offside rule instead of removing.

For international matches, the standard length of a pitch is between 100 and 110 m (FIFA, 2013). Because of the offside rule, only half of the pitch (50 to 55 m) is actively used. If the rules were changed so that the pitch was divided into three equal parts and the offside rule was applied to only one-third of the playing field, then the remaining two-thirds of the playing field (66 to 77 m), might see more active play. Such a modification is named as” Revised Offside Rule” (figure 1). By decreasing the area restricted by the offside rule, the active playing area would be enlarged. Players would be less constricted and have more space to be active. If this rule was implemented, it would open the field for more active play, and spectator satisfaction, one of the main aims of soccer, would most likely increase during the matches.

The aim of this study is to measure the differences in matches which use the revised offside rule (ROR) and the standard offside rule (OR), with regard to the number of short passes, long passes, off-sides, tackles, shots, feints, scoring positions, length of the game, activity profile of players, and speed ranges in which these distances are covered. We hypothesized that revising the offside rule would result, (1) enhance the total distance covered and (2) increase the number of goal possession during a soccer match.

METHODS

Research Group

Combined total of 82 male players (mean age 17±1 years old), participated in the study. Six soccer teams in a U17 and U18 league in Local Amateur League in Izmir-Turkey took part in the study. Only the players which completed the two consecutive matches with two different offside rules were included in the study. The project was approved as a non-invasive study by the Local Ethics Committee with the number of 2011/04-03. Administrators, trainers, players, and the families of the players were given information about the study and written consent was collected from participants in accordance with the Declaration of Helsinki.

Data Collection Instruments

The distances covered by the players and their running speeds were measured using GPS devices which is approximately 50 grams in weight (VXsport, Wellington, New Zealand) attached to the waists of the players using custom-made belts. The same GPS units were used by the same player for two consecutive matches. In recent years, GPS devices have been effectively used for measuring distances covered by players and their running speeds (Vescovi, 2012; Barbero-Alvarez et al., 2012; Gomez-Priz et al., 2011).

To determine the distances covered by the referees during matches, the number of steps they took during each match was measured using pedometers (Kenz EX, Japan). The total steps taken by the referees were tallied in order to determine approximate workloads during matches.

All matches were recorded using a high definition video camera (Sony DCR-SR15E, Japan).

The number of short passes, long passes, feints, tackles, shots, scoring positions and offside violations were determined using analysis software (e-analysis, Turkey). The criteria for technical actions such as short passes, long passes, etc. were similar to those used in other studies (Rampinini et al., 2009).

Data Collection

Teams participating in the study were numbered 1, 2, 3, 4, 5, and 6. Each team played the other teams twice. The second match between two opponents was played three days following the first match. A total of 30 league matches were played. By random assignment, 15 were played using the OR and 15 played using the ROR (Table 1). The matches were played on a 105 x 60 m field. For matches played by the ROR, the pitch was divided into three equal parts of 35 m each (Figure 1).

Table 1. Fixture of the Matches

Week	Day	Match
1. Week	Tuesday	1-2 / 3-4 / 5-6
	Friday*	1-2 / 3-4 / 5-6
2. Week	Tuesday*	2-3 / 4-5 / 1-6
	Friday	2-3 / 4-5 / 1-6
3. Week	Tuesday	1-3 / 2-4
	Friday*	1-3 / 2-4
4. Week	Tuesday*	1-4 / 2-5 / 3-6
	Friday	1-4 / 2-5 / 3-6
5. Week	Tuesday	1-5 / 2-6
	Friday*	1-5 / 2-6
6. Week	Tuesday*	3-5 / 4-6
	Friday	3-5 / 4-6

*Match days played using the revised offside rule (ROR)

The match activity profile of players was measured and compared regarding use of the OR or ROR.

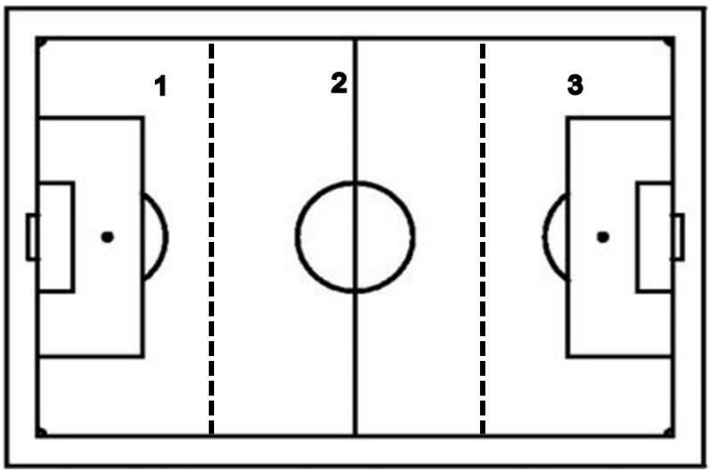

Figure 1. Revised Offside Rule Lines.

In all matches, regulations such as time, clothing, pitch measurements, and number of substitutions were applied according to the Federation Internationale de Football Association (FIFA) rulebook. Certified referees conducted each match. Before the study matches were played, the coaches, players, and referees received detailed instructions about the ROR.

Running speeds were categorized as follows: 1. Walking (0-6.9 km/h) 2. Jogging (7-11.9 km/h) 3. Medium-speed running (12-16.9 km/h) 4. High-speed running (17-21.9 km/h) 5. Sprinting (>22 km/h), (Malone et al., 2016). The total distance covered by a team during a match was measured. Due to equipment limitations, in each match, the players of only one of the teams wore the GPS devices. Goalkeepers did not wear a GPS.

A chronometer was used to record the time in which the ball was in active play. This included when the clock was running but did not include when the game had been stopped for free kicks, timeouts, substitutions, or similar stoppages of play.

Data Analysis

Data analysis was performed using SPSS 15.0. for Windows. Before using parametric tests, the assumption of normality was verified using tests for skewness and kurtosis. Therefore, the Paired t-test provided a hypothesis test of the difference between means of distance covered and notational analysis variables of OR and ROR for a pair of random samples. Statistical significance was determined as $p<0.05$. Data are presented as mean values ± standard deviation.

RESULTS

Distances covered by walking, jogging, medium-speed running, and high-speed running, and total distance covered by players in matches in which ROR was used were significantly greater than in matches in which OR was used (Table 2). Sprinting distances in the matches played under the different rules were not significantly different.

Table 2. Total distance covered and distances covered (mean±SD) at various running speeds in matches played according to standard offside rules (OR) and revised offside rules (ROR).

	OR (n=15)	ROR (n=15)
Total distance (m)	8480.8 ± 622.4	8938.2 ± 432.1*
Walking (m)	4327.5 ± 320.7	4538.6 ± 219.8*
Jogging (m)	2224.2 ± 2,544	2328.4 ± 203.3*
Medium-speed (m)	1215.1 ± 162.7	1314.7 ± 138.8*
High-speed (m)	455.9 ± 66	515.2 ± 77.6*
Sprinting (m)	198.5 ± 57.2	220.9 ± 62.3

*p<0.05

Numbers of short passes and feints were significantly greater in ROR matches, but numbers of offside and long passes were significantly greater in OR matches (Table 3).

Table 3. Match parameters (mean±SD).

	OR (n=15)	ROR (n=15)
Short passes	398.1± 57.2	425.9 ± 62.8*
Long passes	72.2 ± 21.8	59.8 ± 10.1*
Feints	85.1± 15.8	97.9 ± 13*
Shots	19.9±5.5	21.5 ± 6.3
Offsides	9.7 ± 3.6	7.73 ± 3.2*
Tackles	104.4 ±41.6	115.5 ± 39.5
Goal position	17.1± 5.3	17.5 ± 5.7

*p<0.05

The number of steps taken by assistant referees was significantly lower in ROR matches, but the number of steps taken by referees in ROR and OR matches was not significantly different (Table 4).

Table 4. Number of steps taken by the referees (mean±SD).

	OR (n=15)	ROR (n=15)
Referee	8.176 ± 1307	8.921 ± 963
Assistant referee 1	6.144 ± 543	4.330 ± 250*
Assistant referee 2	6.161 ± 358	4.188 ± 336*

*p<0.05

Mean active playing time in OR and ROR matches was not significantly different. (50±4 min vs. 52±3 min, respectively).

DISCUSSION

In the present study, the effects of using two different offside rules protocols in matches was investigated by looking at team performance, variables. The total distance covered in the matches played with the ROR was significantly greater than in matches played with the OR. Significant differences were also found in distances run at all running speeds except sprinting when using the revised and standard offside rules. Similar to our study, for the same age groups, Da Silva et al. (2007) reported the average distance covered by each player as 8,638 m. In a study of U-18 players, Aslan, et al. (2012) found a greater total distance covered 9,900 m. (5,146 m for the 1st half and 4,754 m for the 2nd half) than we did, but the players were allowed 3-minute resting periods for blood lactate sampling. These rest periods may have contributed to the greater distance covered by their participants.

To date, no studies have been published which compare match characteristics and distance covered by players in matches played under different offside rule protocols. One factor which influences the quality of a soccer match is the distance covered while running at high-speed or sprinting (Mohr et al., 2003). Although distance covered while sprinting was not significantly different between the OR and ROR matches, significant differences were seen in other areas which affected the overall qualities of the games. In games using the ROR, the increase in distance covered, may be explained by the larger area of the active playing field, which means the defence has to cover a larger area. In this case, offence has a larger from which to attack - this can increase the tempo of the game. The distances covered with high-speed running could be explained by the availability of this extra active playing space to players.

The number of the short passes was significantly greater in ROR matches. One result of increasing the size of the active playing field is to increase the number of short passes. Upon a larger active playing field, players may have more time to observe and strategize when they have the ball. These factors may have resulted in the greater number of short passes. Interestingly, the number of long passes was lower in ROR matches. The greater number of short passes may have reduced the requirement for long passes. The number of feints was significantly greater in ROR matches. Due to larger active playing field, the urge of players to carry the ball to empty area of the field may have increased, thus the increased number of feints. The number of offside violations was substantially lower in ROR matches, possibly due to the smaller size of the offside area. This is an important result, which can result in fewer interruptions when attacking and could increase both active playing time of the ball and spectator satisfaction.

While there was no significant difference in terms of the number of the steps taken by the main referees during OR and ROR matches, the number of the steps taken by assistant referees was significantly lower in ROR matches. The measurement of steps taken during running, via a pedometer, is considered a valid calculation method (Rowlands et al., 2007). The number of steps taken by the main referees was greater, but not significantly so, in ROR matches. A top class referee travels 11-13 km (Weston et al., 2010; Castagna et al., 2004)). The increase in the total distance covered by the players, the increase in distance covered at high running speeds, and the larger active playing field might also increase the distances needed to be covered by the referees and thereby increase their workload.

The assistant referee moves along the sideline of the pitch, with some exceptions (penalty kicks, etc.). The distance which must be covered is 50 m with OR and 35 m with ROR; the shorter distance to travel in ROR matches may result in a reduced workload for the assistant referees. An assistant referee covers 6000 m approximately during a match (Mallo et al., 2008). Correct positioning of the assistant

referee might influence decisions of the referee in situations such as offside, corner kicks, goal kicks or whether or not the ball passed the goal line. An assistant referee who is less worn out may provide more accurate and consistent assistance to the main referee.

Revised Offside Rule (52.1 minutes) and OR (50.5 minutes) matches did not differ significantly in terms of active playtime. The almost 2-minute difference, although not statistically significant, is very important and may result in increased ball possession by the players, numbers of short passes, tackles, feints and the lower number of offside penalties.

The present study has some limitations. We studied amateur, rather than professional, teams in non-tournament matches. A friendly tournament may not be sufficient to demonstrate behaviour under actual match conditions. We did not collect position-specific data. Defence, middle field and attacking players could be assessed separately in future studies.

Using a revised offside rule, the effective playing area of the soccer field is enlarged. The games using this rule had more short passes and fewer offside penalties. Assistant referees took significantly fewer steps in ROR matches. Games played with ROR implemented may be less congested and more dynamic, thus increasing spectator satisfaction.

In case of changing the offside rule, tactical parameters and physiologic demands of players will differ prominently. Coaches will need novel tactical variations and strategies. In this process, some difficulties and adaptation problems may appear for all stakeholders of soccer.

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A Video-Based Analysis of Rhythmic Accuracy and Maintenance in Junior Tennis Players

Mustafa Sogut[1], Serhat Ayser[2], Gozde B. Akar[2]

[1] Kırıkkale University, Faculty of Sport Sciences, Kırıkkale, Turkey.
[2] METU, Department of Electrical and Electronics Engineering, Ankara, Turkey.

msogut@kku.edu.tr

Abstract

This study mainly focused on the video-based analysis of two parameters of rhythmic ability: rhythmic accuracy (RA) and rhythmic maintenance (RM). The effects of tempo on these parameters were also investigated. The participants were junior competitive tennis players (n= 41, age= 13.46 ± 1.64 years). The video-based analysis system that relies entirely on the features extracted automatically from the audiovisual data was used to determine the RA and RM performances of the participants for the tempos of 44 and 50 bpm. The results revealed that participants significantly performed better RA and RM scores in fast tempo test. In addition, results also indicated that participants had significantly higher scores on accuracy task in both tempos. In conclusion, the study attempted to determine the rhythmic ability via a video based system. Using the proposed system, rhythmic ability analysis can be applied to a wide range of participants in a very short time and further analysis on the collected data can easily be conducted.

Keywords: Rhythmic ability analysis, rhythmic competence, tempo differences, tennis

INTRODUCTION

The nature of tennis requires adaptation to the external stimuli (trajectory, speed, height, and spin of the ball) and thus, participation in tennis training enables children to experience various rhythmic motives with different tempos (Zachopoulou et al. 2000). Depending on the age of the players, opponent, and the court surface, the points in tennis might either end with a single stroke or after a long rally. Therefore, players need to maintain their rhythmic movement patterns not only for a short time but also for a long duration of time.

Rhythmic ability was generally analyzed through its two components, namely, rhythmic accuracy (RA) and rhythmic maintenance (RM). Zachopoulou et al. (2000) defined these components respectively as the synchronization of body movements in a rhythmic stimulus and as the continuous reproduction of a rhythmic motive without the presence of a rhythmic stimulus. The main difference between the tests of RA and RM is the presence and absence of the external rhythmic stimulus. In the literature, there exist two different approaches to carry out the tests for rhythmic ability analysis: observer-based and tool-based. Among these, the Rhythmic Competence Analysis Test (RCAT) is an example for the observer-based method. Weikart (1989) designed RCAT, which includes nonweight-bearing movement, seated, and weight-bearing movement, standing and walking, in order to evaluate an individual's beat competency by testing his/her ability to perform a movement task to the underlying steady beat. The performance of each individual was videotaped and evaluated by examiners.

On the other hand, as an example for the tool-based method, Kioumourtzoglou et al. (1998), Derri et al. (1998), Zachopoulou et al. (2000), and Zachopoulou and Mantis (2001) used a system composed of a metronome for auditory stimulus and a computer with an integrated electronic time switch and three ground-tables with interior mechanical sensors to automatically record the time difference between two continuous steps. Even though the tool-based methods do not depend on the judgement of examiners, they necessitate special equipment for recording the data.

As an alternative to the tool-based methods, in this paper, a novel rhythmic ability analysis system that relies entirely on the features extracted automatically from the audiovisual data was used. The main advantage of the system is that it requires neither special equipment nor expert judgement. Using the video based system analysis, the effects of tempo on the parameters of rhythmic ability were investigated. Additionally, the influences of presence and absence of the external rhythmic stimulus were also compared in two tempos.

METHODS

Subjects

Subjects were male (n= 21, age=13.38 ± 1.75 years) and female (n=20, age=13.55 ± 1.57 years) junior competitive tennis players ($Total_N$= 41, $Total_{Age}$= 13.46 ± 1.64 years). They were informed on the purpose of the study and the testing procedures. Informed consent was signed by the parents of the participants. Ethical approval was obtained from the Human Subjects Ethics Committee of Middle East Technical University.

Data Collection Instruments

The block diagram of the video based analysis system is given in Figure 1.

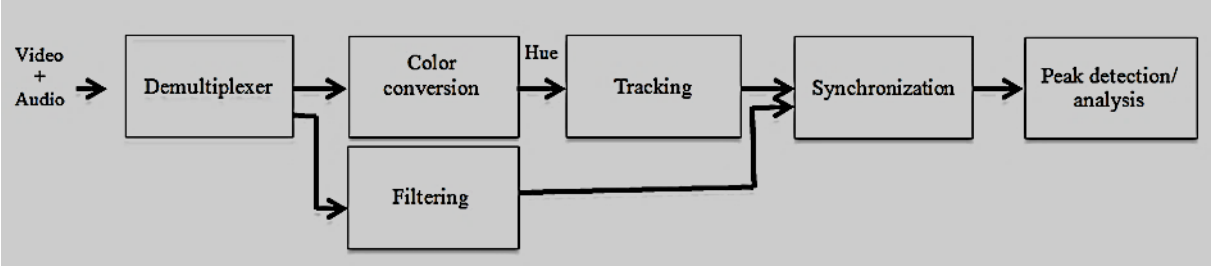

Figure 1. Video based analysis system

In the video based system, the input data was prerecorded video and associated audio. As a first step, the audio and video were de-multiplexed to be processed independently. The audio data was pre-filtered (band-pass filter) to eliminate the surrounding noise so that the metronome beats could be clearly identified. In the meantime, to process the video data, first, each frame of the video is converted from RGB (Red-Green-Blue) color space to HSV (Hue-Saturation-Value) color space since RGB color space is sensitive to illumination and its components are correlated. For further analysis, only the H component of the frames is used. The participants were expected to start from a predetermined location to initialize the algorithm (Figure 2).

Figure 2. Initial shoe locations marked on H component of a video frame

Once the initial boxes shown in Figure 2 were localized, the color content (H) of the boxes was tracked using mean-shift tracking (Ido et al., 2010). Mean-shift tracking algorithm is an iterative scheme based on comparing the color distribution of the interest region in the current frame and color distribution of candidate regions in the next frame. The aim in this approach was to maximize the correlation between two color distributions. The tracked boxes (left and right shoes) used in this method are shown in Figure 3.

Figure 3. The tracked left and right shoes

The tracking was done for the overall duration of the video sequence and the center of mass for each tracked box was plotted. In this plot, the minimum points of the curves give us the tapping instants of

the individuals. Since the sampling rate of the audio and the frame rate of the video were known, the time instants of tapping and the metronome beats were synchronized and overlaid.

Data Collection

The participants were firstly asked to perform 15 steps synchronized with the metronome beats and secondly 35 steps in the absence of the beats. The video and metronome beats were synchronously recorded. For all recorded videos and audios, using video based tool, the time instants of tapping and the metronome beats were determined as described above. Since the period of the metronome beats were known, it was extrapolated for the time duration without any beats. Recorded data were analyzed based on the timing error (in msec) for tapping with and without metronome beats measured as shown in Figure 5 using Equation 1.

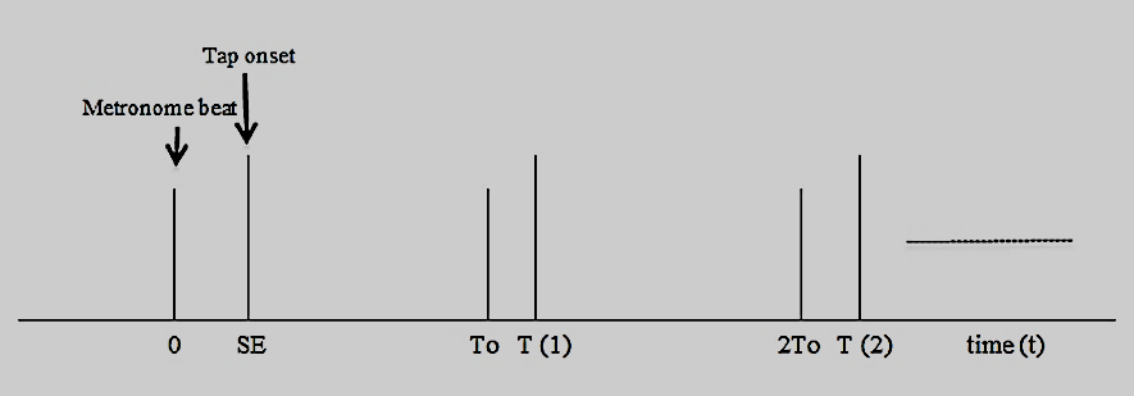

Figure 5. Timing errors

$$T\_Error(t) = T(t+1) - T(t) - To \text{ where } To = \begin{cases} 1.363s \ for\ 44bpm \\ 1.2s\ for\ 50\ bpm \end{cases} \quad (1)$$

SE is the initial synchronization error which is not used in the analysis. Metronome beats are the actual beats for the case of RA and extrapolated beats for the case of RM. In the study of Söğüt et al. (2015), it has been shown that timing errors obtained using the visual analysis tool coincides with the ground truth data obtained using RCAT.

Data Analysis

Descriptive statistics (mean ±SD) were calculated for the RA and RM scores in each tempo and for both genders. The Independent-Samples T Test was initially conducted to determine the gender differences. Since no significant differences were found on both tasks in both tempos data were analyzed regardless of gender. The Paired-Samples T Test was utilized to determine the effects of tempo (44 and 50 bpm) on RA and RM, and to compare the two different components of rhythmic ability for both slow and fast tempos. Statistical significance level was set at $p < 0.05$.

RESULTS

Rhythmic accuracy and maintenance scores of participants at both tempos are presented in Table 1. Results revealed that participants performed better rhythmic ability scores on RA ($t_{(40)} = 3.561$, $p =$

0.001), and RM ($t_{(40)}$ = 2.979, p = 0.005) in the fast tempo test. In addition, results also indicated significant differences between rhythmic ability parameters. Accuracy scores of the participants were better at both slow ($t_{(40)}$ = - 4.027, p = 0.000) and fast tempo tests ($t_{(40)}$ = -3.954, p = 0.000) than the maintenance scores.

Table 1. Descriptive statistics (mean ± standard deviation) for RA and RM scores (sec) in both tempos

Variables	**RA**		**RM**	
Tempo (bpm)	44	50	44	50
Male	0.078 ± 0.026	0.067 ± 0.023	0.116 ± 0.060	0.087 ± 0.033
Female	0.075 ± 0.032	0.057 ± 0.018	0.100 ± 0.039	0.078 ± 0.029
Overall	0.077 ± 0.029	0.062 ± 0.021	0.108 ± 0.051	0.082 ± 0.031

DISCUSSION

The preliminary objective of this study was to determine the rhythmic accuracy and rhythmic maintenance through using a video-based analysis system. The role of tempo on these parameters was also examined. The results revealed that participants performed better scores on fast tempo test in both tasks. In other words, synchronization of the participants with the external stimuli was more precise when the time interval was shorter.

This result contrasts with the findings of Agdiniotis et al. (2009). In their study 180 pre-school children were tested with RCAT at the tempos of 120 and 130 bpm and significantly better performances were reported in the slower testing tempo. On the other hand, the result is in line with the studies of Kumai and Sugai (1997), Zachopoulou et al. (2000), and Mastrokalou and Hatziharitos (2007). Zachopoulou et al. (2000) studied the rhythmic accuracy and maintenance of children participating regularly swimming, tennis and basketball training, and controls. A laboratory instrument, involving a metronome and auditory stimulus, was used to measure rhythmic ability of the participants at two different tempos (44 and 50 bpm). As a consequence, performance of the overall children on both tasks was stated to be superior in the fast tempo test. According to Fraisse (1982), the possibility of rhythmic perception depends on tempo. Involvement of cognitive mechanism in the longer time intervals might cause deficiency in rhythmic ability performance (Mastrokalou and Hatziharitos, 2007).

The results of this study also indicated differences between two parameters of rhythmic ability. Participants significantly performed better scores on rhythmic accuracy than rhythmic maintenance at both slow and fast tempos. Namely, rhythmic ability of the participants was more precise when they stepped synchronized with the metronome beats than stepped in the absence of the beats. Zachopoulou et al. (2000) reported contrasting results. They found no differences between RA and RM scores of tennis and basketball players within the same tempo. Besides, the maintenance performance of the swimming group was found better than the accuracy performance. However, supportive findings were observed from the study of Mastrokalou and Hatziharitos (2007). They found higher scores on rhythmic accuracy. Although rhythmic ability was studied vastly in sport sciences literature there has been limited evidence so far regarding the discrepancy between these parameters.

In conclusion, the study attempted to determine the rhythmic accuracy and maintenance by means of a

video base system. Using the tool, the influences of tempo on rhythmic accuracy and maintenance were investigated at two different tempos. The tempo was found to be an effective factor on rhythmic ability. Since the evaluation was automatic, using the proposed system, rhythmic ability analysis can be applied to a wide range of participants in a very short time and further analysis on the collected data can easily be conducted.

Authors Note

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