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THE EVALUATION OF PHYSICAL AND MOTORIC CHARACTERISTICS OF YOUNG SWIMMING ATHLETES

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Abstract
Purpose: The aim of this study was to evaluate the effect of national programs which is planned policies for swimming that important contribution on train for champion athletes in our nation and the effect of these programs on physical and motor characteristics of volunteers who participated in our study.
Methods and Procedures: Seventy-two volunteers including 36 boys and 36 girls which is between the ages of 8 and 12 attended in the research. The volunteers were divided into 3 groups as the elite group, developing group and the control group. Control group volunteers were primary school students who nonparticipating physical education lessons and nonattendance in any sports activity during research. As pre and post test, physical characteristics which age, height, weight, body mass index (BMI), body fat percentage, and motor characteristics which are flexibility, hand grips, sit-up test, four min. swimming, 25 m sprint swimming were measured of volunteers groups who participated in the study. It was carried out that five times a week training which 80 % swimming and 20 % dryland to elite and developing groups during the 24 weeks. It was performed that four times endurance and one time sprint training of carried out five times a week training.
Statistical analysis was carried out using Wilcoxon Rank Test for determine the significance of the difference pre and post tests within-groups. Also, Mann-Whitney U Test carried out for determine the significance of the differences among intergroups. The significance level was determined as $p<0,05$
Results: When within-group and intergroup test results were compared, significant decrease were found in the BFP, BKI and significant decrease in the height, hand grips, flexibility, sit-up test, four min. swimming test, 25m swimming test results in favor of the elite group ($p<0,05$).
Conclusions: As a result of training, decrease of body fat percentage, BMI, and increased of both height, hand grips, flexibility, sit-up test, four min. swimming test, 25 m swimming scores and increased of athletic performance was observed. The reasons of these results are related to each other motor functions and athletic performance. Although it was carried out to same training programme to all volunteer athletes, significant differences were observed in the physical characteristics and motor functions in favor of the elite group. We thought that the reasons of these results were gained psychomotor fundamentals, long sport age and probably genetic factors of elite athletes to affect on the both anthropometric parameters and motor functions. It has been thought that these factors get improve athletic skills of elite athletes.

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Introduction

A lack of physical activity has been implicated as a risk factor for the development of overweight and following unhealthy life, and increases in children's physical activity and sport participation have been advocated to prevent or reduce childhood overweight and following unhealthy life. In addition, physical activity has been associated with positive health outcomes among children and adolescents (K.K. Davison, M.B. Earnest, L.L. Birch, 2002).

It is accepted that increased physical activity and musculoskeletal stress are important for promoting growth in children (K.T. Borer, 1995). Moreover, children's involvement in sport training might provide particular long-term health benefits (T.W. Rowland, 2005). Swimming contributes to the development of healthy posture and biomotoric functions of children. (J.M. Stager, D.A. Tanner, 2005)

In terms of competition, it is observed that the started of the training at a young age for be able to train champion athletes in many sports. Many countries implements planned training programs for both healthy development and train champion athletes. For these purpose children are canalized to swimming and they receive regular training in our country.

The aim of this study was to evaluate the effect of national programs which planned policies for swimming that important contribution on train for champion athletes in our nation and the effect of

these programs on physical and motor characteristics of volunteers who participated in our study.

Material and method

Seventy-two volunteers including 36 boys and 36 girls which is between the ages of 8 and 12 attended in the research. The volunteers were divided into 3 groups as the elite group, developing group and the control group. Elite group was composed to 12 boys volunteers who mean age of 10,3 ± 1,8 years and 12 girls volunteers who 10,2 ± 1,3 years, developing group was composed to 12 boys volunteers who mean age of 9,7 ± 1,3 years and 12 girls volunteers who 9,3 ± 0,8 years, control group was composed to 12 boys volunteers who mean age of 9,7 ± 1,3 years and 12 girls volunteers who 9,3 ± 0,8 years and all control group volunteers were primary school students who nonparticipating physical education lessons and nonattendance in any sports activity during research. It was carried out that five times a week training which 80 % swimming and 20 % dryland to elite and developing groups during the 24 weeks. It was performed that four times endurance and one time sprint training of carried out five times a week training. All measurements were taken twice as pre and post test.

Height and body weight of volunteers were measured using the Tanita Body Composition Analyzer (Type TBF-410 MA, JAPAN) brand device. Body Mass Index of volunteers was calculated by body weight (kg) / height² (m²) formula (W. R. Thompson, N. F. Gordon, L. S. Pescatello, 2009)

Body Fat Percentage: Skinfold thickness was measured at the right side of the body at the biceps, triceps, subscapular, and suprailiac sites using Holtain skinfold kaliper. Skinfold thickness was taken three times at each body site and the average was recorded. Body fat percentage was calculated using Durnin-Womersley formula (G.B. Dwyer, S.E. Davis, 2008).

Flexibility: Sit-reach test was performed for the measurement of flexibility. For the sit-and-reach test, a yardstick was placed on the floor and tape was placed across it at a right angle to the 38 cm mark. The volunteers sat with the yardstick between the legs, with legs extended at right angles to the taped line on the floor. Heels of the feet touched the edge of the taped line and were about 25 cm to 30 cm apart. The volunteers reached forward with both hands as far as possible, holding this position ~2 seconds. The most distant point reached with the fingertips was recorded. The better of two trials was recorded (W. R. Thompson, N. F. Gordon, L. S. Pescatello, 2009).

Hand Grips Strength: Right and left hand grips were measured using Grip Strength Dynamometer T.K.K. 5101 Grip-D. The volunteers were standing for the test. The volunteers held the handgrip dynamometer parallel to the side of the body at about waist level. The forearm was held level with the thigh. The volunteers then squeezed the hand grip dynamometer as hard as possible. The better of two trials was recorded in kilograms (G.B. Dwyer, S.E. Davis, 2008).

30 sec. Sit-up Test: Sit-up test was conducted by counting the maximum number of sit-ups achievable in 30 s. In the test, the shoulders were touching the mat in the lying position and elbows were touching the flexed knees in the sitting position (A. Heinonen, et al., 2000).

Four min. Swimming Test: Before the test implementation, the volunteer athletes were warmed up out of the swimming pool and were swum 200m with crawl technique in the swimming pool. The athletes swam with crawl technic during 4 minute continuously. The athletes swum in groups in the form of six people. When the time was over, the athletes were stopped with metal apparatus underwater and by whistling out of water. The test was performed one time.

25 m Sprint Swimming Test: The test was performed in the 25m swimming pool. Before the test implementation, the athletes were warmed up out of the swimming pool and were swum 200m with crawl technique in the swimming pool. The athletes were given the start signal from inside the swimming pool and were swum the distance with crawl technique. When the athletes pushed the wall of the pool, the time was started and the time was stopped when they touched the front wall. The measurement was taken two times and the better time was recorded.

Statistical Analysis: Statistical analysis was carried out using Wilcoxon Rank Test for determine the significance of the difference pre and post tests within-groups. Also, Mann-Whitney U Test carried out for determine the significance of the differences among intergroups. The significance level was determined as $p<0,05$

Results

The comparisons of the test results among intergroup weren't shown in tables. According to these comparisons, when the pre-test results were compared between boys elite and developing groups, statistical significant were found in the four min. swimming test, right hand grip strenght, sit-up test and 25m sprint swimming test results in favor of the elite group ($p<0,05$), when the post-test results were compared, statistical significant was found also in the left hand grip results in addition to these findings in favor of the elite group ($p<0,05$). When the girls elite and developing groups pre-test results were compared, statistical significant were observed in the weight, sit-up test, four min. swimming test, 25m sprint swimming test results in favor of the elite group ($p<0,05$), when the post-test results were compared statistical significant was found also in the BMI results in addition to these findings in favor of the elite group ($p<0,05$). When the boys elite and control groups pre-test results were compared,

statistical significant were found in the BMI, body fat percentage, flexibility, right hand grip, and sit-up test results in favor of the elite group (p<0,05), when the post-test results were compared statistical significant was found also in the left hand grip results in addition to these findings in favor of the elite group (p<0,05). When the girls elite and control groups pre-test results were compared, statistical significant were observed in the height, BMI, body fat percentage, flexibility, right and left hand grips, sit-up test results in favor of the elite group (p<0,05), when the post-test results were compared statistical significant were found same results in favor of the elite group (p<0,05). When the boys developing and control groups pre-test results were compared, statistical significant were found in the BMI, body fat percentage, and sit-up test results in favor of the developing group (p<0,05), when the post-test results were compared statistical significant were found same results in favor of the developing group (p<0,05). When the girls developing and control groups pre-test results were compared, statistical significant were observed in the weight, BMI, body fat percentage, sit-up test results in favor of the developing group (p<0,05), when the post-test results were compared statistical significant was found also in the height and flexibility results in addition to these findings in favor of the developing group (p<0,05).

Table 1. The Comparison of Pre-test and Post-test Values of the Elite Groups

			BOYS			GIRLS			
Parameters	**n**	**Tests**	**Mean ± SD**	**z**	**p**	**N**	**Mean ± SD**	**z**	**p**
Age (year)	12	Pre test	10,33 ± 1,86	0,000	1	12	10,46 ± 1,33	-,356	0,722
	12	Post test	10,33 ± 1,86			12	10,25 ± 1,42		
Height (cm)	12	Pre test	145,5 ± 20,57	-1,761	0,078	12	143,23 ± 11,86	-,764	0,445
	12	Post test	148 ± 19,86			12	144,66 ± 10,84		
Weight (kg)	12	Pre test	36,36 ± 13,15	-1,36	0,173	12	34,53 ± 9,26	-1,020	0,308
	12	Post test	37,83 ± 12,31			12	35,50 ± 9,29		
BMI (kg/m²)	12	Pre test	1,32 ± 0,06	-1,153	0,249	12	4,31 ± 0,71	-,941	0,347
	12	Post test	1,31 ± 0,05			12	4,22 ± 0,64		
Body Fat Percentage(%)	12	Pre test	13,68 ± 4,74	-2,201	**0,028***	12	15,62 ± 3,97	-,746	0,456
	12	Post test	11,61 ± 3,73			12	15,19 ± 4,41		
Four min. Swimming(m)	12	Pre test	254,33 ± 23,88	-2,207	**0,027***	12	267,84 ± 17,79	-3,062	**0,002***
	12	Post test	289,33 ± 7,52			12	292,66 ± 6,42		
Flexibility (cm)	12	Pre test	23,08 ± 3,24	-2,032	**0,042***	12	27,30 ± 4,74	-,059	0,953
	12	Post test	24 ± 3,16			12	27,83 ± 3,24		
Right Hand Grip (kg)	12	Pre test	19,51 ± 7,04	-2,201	**0,028***	12	17 ± 4,68	-,235	0,814
	12	Post test	21,48 ± 8,50			12	16,0 1 ± 4,05		
Left Hand Grip (kg)	12	Pre test	18,7 ± 8,09	-2,201	**0,028***	12	16,96 ± 5,68	-,314	0,754
	12	Post test	20,58 ± 8,58			12	14,95 ± 4,62		
25m Sprint Swimming (sec)	12	Pre test	19,97 ± 0,84	-2,201	**0,028***	12	19,04 ± 1,15	-3,061	**0,002***
	12	Post test	17,58 ± 0,83			12	17,35 ± 0,62		
30 sec Sit-up (scor)	12	Pre test	24,33 ± 3,72	-2,226	**0,026***	12	23,76 ± 3,24	-2,627	**0,009***
	12	Post test	31,16 ± 6,58			12	28,91 ± 6,74		

*** p < 0,05**

Comparison of pre and post-test values of the boy elite group and comparison of pre and post-test values of the girl elite group are shown in table 1. According to table 1, significant differences were observed in the body fat percentage, four min. swimming test, flexibility, right and left hand grips, 25m sprint swimming test and sit-up test results of boy elite group (p<0,05), significant differences were observed in the four min. swimming test, 25m sprint swimming test and sit-up test results of girl elite group (p<0,05).

Comparison of pre and post-test values of the boy developing group and comparison of pre and post-test values of the girl developing group are shown in table 2. According to table 2, significant differences were found in the height, four min. swimming test, 25m sprint swimming test and sit-up test results of boy developing group (p<0,05), significant differences were found in the height, BMI, four min. swimming test, flexibility, left hand grip, 25m sprint swimming test and sit-up test results of girl developing group (p<0,05).

Table 2. The Comparison of Pre-test and Post-test Values of the Developing Groups

			BOYS			GIRLS			
Parameters	**n**	**Tests**	**Mean ± SD**	**z**	**p**	**N**	**Mean ± SD**	**z**	**p**

Age (year)	12	Pre test	9,66 ± 1,3	-1	0,317	12	9,28 ± 0,82	-1	0,317
	12	Post test	9,75 ± 1,28			12	9,35 ± 0,84		
Height (cm)	12	Pre test	137,25 ± 11,55	-3,077	**0,002***	12	133,57 ± 7,24	-3,298	**0,001***
	12	Post test	142,08 ± 11,56			12	137,85 ± 8,60		
Weight (kg)	12	Pre test	32,67 ± 7,16	-1,475	0,140	12	28,35 ± 4,05	-0,722	0,470
	12	Post test	34,08 ± 8,56			12	30,32 ± 3,17		
BMI (kg/m²)	12	Pre test	1,33 ± 0,03	-0,628	0,530	12	4,77± 0,50	-2,542	**0,011***
	12	Post test	1,33 ± 0,04			12	4,97 ± 0,38		
Body Fat Percentage(%)	12	Pre test	16,31 ± 6,18	-0,510	0,610	12	15,39 ± 4,01	-1,697	0,090
	12	Post test	16,17 ± 7,07			12	14,51 ± 4,27		
Four min. Swimming(m)	12	Pre test	193,91 ± 23,41	-3,061	**0,002***	12	200,21 ± 15,62	-3,297	**0,001***
	12	Post test	225,16 ± 16,11			12	227,28 ± 16,05		
Flexibility (cm)	12	Pre test	18,29 ± 7,54	-1,829	0,067	12	25,07 ± 5,95	-2,532	**0,011***
	12	Post test	20 ± 7,5			12	27,32 ± 4,44		
Right Hand Grip (kg)	12	Pre test	15,25 ± 4,92	-0,275	0,783	12	13,86 ± 2,74	-1,006	0,315
	12	Post test	15,67 ± 6,54			12	13,37 ± 1,82		
Left Hand Grip (kg)	12	Pre test	15,67 ± 5,73	-1,138	0,255	12	13,71 ± 2,68	-2,062	**0,039***
	12	Post test	14,9 ± 6,25			12	12,33 ± 1,93		
25m Sprint Swimming (sec)	12	Pre test	26,46 ± 5,76	-3,059	**0,002***	12	24,48 ± 3,80	-3,180	**0,001***
	12	Post test	19,98 ± 1,18			12	20,62 ± 1,41		
30sec. Sit-up (scor)	12	Pre test	18,75 ± 2,41	2,448	**0,014***	12	19,21 ± 3,16	-3,203	**0,001***
	12	Post test	21,25 ± 3,93			12	24,57 ± 5,58		

*** p<0,05**

Table 3. The Comparison of Pre-test and Post-test Values of the Control Groups

			BOYS			**GIRLS**			
Parameters	**n**	**Tests**	**Mean ± SD**	**Z**	**p**	**N**	**Mean ± SD**	**z**	**p**
Age (year)	12	Pre test	9,66 ± 1,30	0,000	1	12	9,28 ± 0,82	0,000	1
	12	Post test	9,66 ± 1,30			12	9,28 ± 0,82		
Height (cm)	12	Pre test	134,75 ± 11,40	-2,694	**0,007***	12	131,07 ± 7,08	-2,944	**0,003***
	12	Post test	136,83 ± 11,52			12	133,85 ± 6,01		
Weight (kg)	12	Pre test	37,16 ± 7,67	-2,130	**0,033***	12	32,71 ± 4,15	-2,326	**0,020***
	12	Post test	39,04 ± 8,18			12	34,82 ± 4,49		
BMI (kg/m²)	12	Pre test	1,29 ± 0,03	-1,804	0,071	12	4,04 ± 0,38	-0,785	0,433
	12	Post test	1,28 ± 0,04			12	4 ± 0,44		
Body Fat Percentage(%)	12	Pre test	20,34 ± 6,19	-3,063	**0,002***	12	16,41 ± 4,02	-3,298	**0,001***
	12	Post test	21,72 ± 5,99			12	19,22 ± 3,6		
Flexibility (cm)	12	Pre test	14,16 ± 6,62	-1,890	0,059	12	20,64 ± 6,12	-0,447	0,655
	12	Post test	14,41 ± 6,59			12	20,60 ± 5,97		
Right Hand Grip (kg)	12	Pre test	13,32 ± 4,94	-0,276	0,783	12	11,94 ± 2,61	-1,194	0,233
	12	Post test	13,36 ± 5,11			12	11,82 ± 2,51		
Left Hand Grip (kg)	12	Pre test	13,93 ± 5,81	-1,786	0,074	12	11,73 ± 2,69	-0,598	0,55
	12	Post test	14,1 ± 5,73			12	11,67 ± 2,81		
30sec. Sit-up (scor)	12	Pre test	14,16 ± 2,58	0,000	1	12	14,64 ± 3,24	0,000	1
	12	Post test	14,16 ± 2,58			12	14,64 ± 3,24		

*** p<0,05**

Comparison of pre and post-test values of the boy control group and comparison of pre and post-test values of the girl control group are shown in table 3. According to table 3, significant differences were observed in the height, weight, body fat percentage results of boy control group (p<0,05), significant differences were observed in the height, weight, body fat percentage results of girl control group (p<0,05).

Discussion

When the test results were compared intergroup of boy volunteers, it has been observed that left hand grip was increase in the post-test in addition to pre-test results (p<0,05). We thought that this increase of left handgrip in favor of the elite group may be carried out dryland and swimming training. A number of studies have been conducted on both children and adolescents and have clearly demonstrated that athletic training is effective in increasing strength (J.H. Wilmore, D.L. Costill, W.L. Kenney, 2008). Swimming has important contributions to strenght and conditioning because it is carried out against water resistance (I. Gokhan, R. Kurkcu, H.A. Aysan, 2011). The percentage increases for children and adolescents are similar to

those for young adults (J.H. Wilmore, D.L. Costill, W.L. Kenney, 2008). Prepubescent strength gains are accomplished largely without any changes in muscle size. A comprehensive study of the mechanisms responsible for strength increases in prepubescent boys concluded that the likely determinants of the strength gains achieved are improved motor skill coordination, increased motor unit activation, and other neurological adaptations. Strength gains in the adolescent result primarily from neural adaptations and increases in both muscle size and specific tension (J.A. Ramsay, et al., 1990). Generally, left hand strenght is lower than the right hand strength because of commonly used right hand as dominant. In this study, we think that total strenght increased owing to training, in parallel with this increase left hand grip strenght which is neglected increase, too.

When the girl elite and developing groups pre-test results were compared between each other and post-test results were compared between each other, significant decrease were observed in the BMI in the post-test in addition to pre-test results in favor of the elite group ($p<0,05$). When the girl elite and control groups pre-test results were compared between each other and post-test results were compared between each other, there were no significant differences in the post-test in addition to pre-test results. When the girl developing and control groups pre-test results were compared between each other and post-test results were compared between each other, significant differences were observed in the height and flexibility in the post-test in addition to pre-test results in favor of the developing group ($p<0,05$). According to these results, dryland and swimming training has caused decrease in the BMI value of elite group, and increase in the height, flexibility values compared with the control group. Althoug no significant differences in the weihgt and height, weight values decreased and height values increased in favor of the elite group after the training program. For this reason, it was thought that significant decrease was observed in the BMI as a result of carried out training program. In parallel with our study, Sanders found significant decrease in BMI values of elite swimmers who 12 ages (R.H. Sanders, 2007). We think that the reason of increase in the height is growth and developing period of volunteers, at the same time, we think that carried out training has effect on the growht factors. Although carried out to same training programme the reason of significant differences in the height value only in favor of developing group may be genetic factors. In addition, we think that significant increase in the flexibility of developing group may be applied swimming exercise. Flexibility is an important factor in human athletic performance (N. Maffulli, J.B. King, P. Helms, 1994). Flexibility may contribute to improved physical performance, reduced energy requirements for movement of joints (because of reduced tissue tension), and reduced likelihood of soreness or injury with physical exercise (N.A. Segal, et al., 2004**)**. Thus, improved flexibility observed in this swimming exercise program suggests an important health benefit, and athletic requirement.

When within-group pre-post test results were compared, significant increases were observed in the height, weight, body fat percentage values in the post test of both boy and girl control groups. This situation was considered as a feature of normal growth period. When pre-post test results of boy elite group were compared, significant differences were observed in the body fat percentage, four min. swimming test, flexibility, right and left hand grips, 25m sprint swimming test and sit-up test results. When pre-post test results of girl elite group were compared, significant differences were observed in the four min. swimming test, 25m sprint swimming test and sit-up test results. When pre-post test results of boy developing group were compared, significant increases were observed in the height, four min. swimming test, 25m sprint swimming test and sit-up test results. When pre-post test results of girl developing group were compared, significant differences were observed in the height, BMI, four min. swimming test, flexibility, left hand grip, 25m sprint swimming test and sit-up test results.

We think growth and developing period of volunteers result in significant increase in the height of developing groups, at the same time, we think that carried out training may effect on the growht factors. The reason of significant decrease in the BMI of girl developing group is significant increase in heigth and although no significant decrease in weight nevertheless decrease in the weight value. In parallel with our findings Sideraviciūte and his colleauges found significant decrease in the BMI of swimmers who 10-12 ages as a result of training (S, Sideraviciūte, et al., 2004). As a result of carried out training were observed significant decrease in body fat percentage closely related to performance of athlete groups. Body composition can chance substantially with exercise. Such change can be of major importance in achieving optimal athletic performance. Less fat generally leads to better performance (J.H. Wilmore, D.L. Costill, W.L. Kenney, 2008). In paralel with our findings Damsgaard and his colleauges were found significant differences in the body fat percentage of swimmers who 9-13 ages as a result of 6 month training in their study. (R. Damsgaard, et al, 2001).

The child and adolescent respond to physical training similarly to adults with respect to changes in body weight and composition. With both resistance and aerobic training, both boys and girls will decrease body weight and fat mass and increase fat-free mass, although the increase in fat-free mass is attenuated in the child compared with the

adolescent and adult. There is also evidence of significant bone growth as a result of exercise training, above that seen with normal growth (J.H. Wilmore, D.L. Costill, W.L. Kenney, 2008). In fact, Bass suggested that the prepubertal years may be the most opportune time to increase bone mass because of increases in bone density and periosteal expansion of cortical bone (S.L, Bass, 2000). Physical training and an active lifestyle are critical throughout the growing years to maintain a healthy body composition and establish a lifelong habit of exercise and activity (J.H. Wilmore, D.L. Costill, W.L. Kenney, 2008).

Exercises have positive effects on flexibility (N. Maffulli, J.B. King, P. Helms, 1994). We thought that significant increase in the flexibility may be carried out training. A number of studies have been conducted on both children and adolescents and have clearly demonstrated that athletic training is effective in increasing strength (J.H. Wilmore, D.L. Costill, W.L. Kenney, 2008). In addition, swimming has important contributions to strenght because it is carried out against water resistance (I. Gokhan, R. Kurkcu, H.A. Aysan., 2011). We thought total strenght increased owing to carried out training programme, in parallel with this increase, left hand grip strenght which is often neglected increased, too.

As a result of carried out training significant increase was observed in the sit-up test result. In parallel with our findings, Heinonen and his colleauges found significant increases in the sit-up test results of swimmers at the end of the training programme (A. Heinonen, et al., 2000).

We thought that significant developments in the 25m sprint swimming test and four min. swimming tests of athletes groups were carried out training programme. These results show that exercises have positive effect on the athletes performance. In parallel with our study, Toubekis and his colleauges found significant differences in the 50m crawl swimming results of athletes at the end of the three-month interval training (A.G. Toubekis, et al., 2006).

In conclusion, as a result of training, decrease of body fat percentage, BMI, and increased of both height, hand grips, flexibility, sit-up test, four min. swimming test, 25 m swimming scores and increased of athletic performance were observed. The reasons of these results are related to each other motor functions and athletic performance. Although it was carried out to same training programme to all volunteer athletes, significant differences were observed in the physical characteristics and motor functions in favor of the elite group. We thought that the reasons of these results were gained psychomotor fundamentals, long sport age and probably genetic factors of elite athletes to affect on the both anthropometric parameters and motor functions. It has been thought that these factors get improve athletic skills of elite athletes.

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