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URBAN AND RURAL FITNESS LEVEL: COMPARISON BETWEEN ITALIAN AND CROATIAN STUDENTS[1, 2]

Summary.—The goal of this study was to investigate the differences in physical fitness in relation to urban or rural living environment and between two countries: Italy and Croatia. Over 14,000 students were tested during physical education (PE) lessons. Croatian students were taller and heavier than Italian students, with women achieving better results in flexibility. Urban students were fitter in abdominal strength than rural students. Age seemed to be the major factor influencing the performance. This study's results indicate a trend: urban students performed "indoor" tests better than rural students; the opposite may be true for rural students. Living environment, socio-economic-status, or cultural correlation differences could be decreased during school experiences. Thus, PE programs could train all people toward an adequate, age-based fitness level.

The health-related benefits of physical activity are well known. Participation in physical activities and sport can promote social well-being, as well as physical and mental health, among children and adolescents. Environmental factors (Malina, Peña Reyes, & Little, 2008), geographic variability (Tomkinson, Olds, & Borms, 2007), lifestyle, dietary habits (Hebbelinck, Clarys, & De Malsche, 1999), cultural differences, and socio-economic status (Freitas, Maia, Beunen, Claessens, Thomis, Marques, *et al*., 2007) may influence the fitness of young people (Strauss & Pollack, 2001). For example, sedentary lifestyles increased with poor physical activity experience, more notably in urban areas (Seefeldt, Malina, & Clark, 2002; Ozdirenç, Ozcan, Akin, & Gelecek, 2005); but this could have dif-

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ferent expressions across countries. Indeed, in their meta-analysis, Tomkinson, *et al*. (2007) found that European students in northern countries outperformed the students from southern countries on several physical fitness measurements.

The availability of equipment, gymnasium space, swimming pools, running tracks, and playing fields, and the convenience of reaching and using these facilities, are important factors for involvement in sports activities (Malina, *et al*., 2008). Differences in eating habits, access to sport facilities, and opportunities for physical fitness activities can depend on the population density of an area. Physical education in school is crucial to proper physical activity levels (Hardman, 1999), as are family traditions (Sauka, Priedite, Artjuhova, Larins, Selga, Dahlström, *et al*., 2011), socioeconomic factors (Tomkinson, *et al*., 2007), and living environments (Carlson, Sallis, Kerr, Conway, Cain, Frank, *et al*., 2014).

Time spent outdoors and the availability of green spaces in close proximity are especially important for younger children, as they depend on other people for transportation to places where they can be physically active. For example, Sallis and colleagues (Sallis, Alcaraz, McKenzie, Hovell, Kolody, & Nader, 1992; Sallis, Alcaraz, McKenzie, & Hovell, 1999) found that "parents transporting their children to exercise facilities" was an element significantly associated with physical activity. Plotnikoff, Bercovitz, and Loucaides (2004) found that high school students in rural environments smoked more and were more overweight than those in urban environments, possibly indicating less availability of formal spaces for activities. There are contradictory opinions about fitness levels: (1) in urban environments, people are more sedentary because the context leads to inactive life style, while those in rural environments could take advantage of green space; (2) in urban environments, people have more possibilities for physical activity because sport facilities are available, while in rural contexts people spent much time in manual and/or farm work (Malina, 1996; Wilcox, Castro, King, Housemann, & Brownson, 2000; Kabagambe, Baylin, Siles, & Campos, 2002; Parks, Housemann, & Brownson 2003; Malina, *et al*., 2008)

In Southern European countries and in Cyprus, studies have assessed the differences between urban and rural populations (Ozdirenç, *et al*., 2005; Tsimeas, Tsiokanos, Koutedakis, Tsigilis, & Kellis, 2005; Tinazci & Emiroglu, 2009). Tsimeas, *et al*. (2005) investigated physical fitness in relation to body fat in urban and rural Greek children. In particular, they found equivalent levels of body fat between rural and urban children, no effect of place of residence on physical fitness, and significant differences only in the vertical jump performance and in basketball throw trials in favor of urban students. Effect sizes were small. Ozdirenc, *et al*. (2005) evaluated the effects of two different environments on lifestyle, leisure time

activities, and physical fitness. They found similar cardiopulmonary performance between the groups but better results in flexibility and muscle endurance for rural students (effects of sizes 0.82 and 0.63, respectively). These specific studies were done in Greece and Turkey (Southeast Mediterranean region), while in the Northeast Mediterranean region there have been few investigations.

The goal of this study, as suggested by Ozdirenç, *et al*. (2005) and Tsimeas, *et al*. (2005), was to investigate the differences in physical fitness in students in relation to their urban or rural living environment in an area that is in the center of Europe and is affected by traditions and social influences from both Northern and Southern Europe.

The first goal was to establish a baseline of fitness among youth in two different urban contexts. In particular, students from two countries (Italy and Croatia) with different levels of industrialization and thus differing histories of economic development (Italy is the most industrialized country in the Mediterranean region) were compared (CIA, 2011). The second goal was to identify differences in fitness depending on rural versus urban living environment. It is important to identify trends in youth fitness within different environments and among countries with various opportunities.

Hypothesis 1. The urban group would be fitter than the rural group (Tsimeas, *et al*., 2005).

Hypothesis 2. The Italian group would have higher fitness than the Croatian group due to economic resources and availability of sport facilities (Freitas, *et al*., 2007; Carlson, *et al*., 2014).

Method

Participants

During the 2011–2012 school year, the Italian Scholastic System implemented the Motorfit project (Lovecchio, Bussetti, & Eid, 2009; Lovecchio, Casolo, Invernizzi, & Eid, 2012; Lovecchio, Merati, Guasti, Casolo, & Eid, 2013), with a wide sample of students recruited among various schools. At the same time, a parallel protocol was developed to collect the same type of data in Croatia. All students assessed in Italy were living in the northern area, while Croatian students were from all the territory around Zagreb. There were 7,286 Italian students and 7,611 Croatian students. See Table 1 for demographics and numbers of students.

All students were healthy and active during Physical Education (PE) classes and had no present or past physical impairments or diseases. Each participating student was placed into categories of Urban or Rural, respectively, based on whether they were living in metropolitan or rural agricultural areas. The categorization was carried out following the criteria

TABLE 1
DESCRIPTIVE STATISTICS OF ANTHROPOMETRIC CHARACTERISTICS OF ITALIAN AND CROATIAN RURAL AND URBAN STUDENTS

Group, Sex, Living Environment		Age (yr.)	*n*	Height (cm)		Body Weight (kg)		Body Mass Index (kg/m^2)	
				M	*SD*	*M*	*SD*	*M*	*SD*
Croatian									
Female	Rural	11	341	151.38	7.63	44.84	11.42	19.58	3.88
		12	312	156.69	6.91	50.47	11.84	20.40	3.84
		13	330	161.77	6.23	54.16	10.97	20.67	3.60
		14	330	164.00	6.08	57.21	9.75	21.01	3.03
	Urban	11	663	152.40	7.99	45.81	10.89	19.87	3.67
		12	703	158.41	6.96	50.17	11.24	19.99	3.64
		13	835	162.72	6.71	54.38	10.42	20.59	3.38
		14	320	165.76	6.73	58.22	12.21	21.11	3.72
Male	Rural	11	354	149.20	7.09	43.70	10.69	21.11	3.53
		12	361	155.82	8.07	49.89	12.13	21.78	3.60
		13	331	163.55	9.16	55.91	14.43	21.88	4.41
		14	364	170.68	8.60	61.55	13.41	21.16	3.37
	Urban	11	624	151.25	7.61	45.12	10.96	21.22	3.48
		12	704	156.65	8.23	50.22	12.08	21.56	3.69
		13	669	164.45	8.51	56.19	12.73	21.36	3.74
		14	360	170.41	8.40	60.87	12.43	21.43	3.29
Italian									
Female	Rural	11	448	149.31	7.05	42.43	10.19	18.89	3.61
		12	390	155.65	6.00	47.21	9.07	19.36	3.00
		13	370	158.38	6.18	51.35	8.27	20.43	2.97
		14	312	161.00	6.44	55.31	10.75	21.14	3.65
	Urban	11	503	149.63	8.02	41.74	7.95	18.56	2.68
		12	502	155.62	6.62	45.78	8.27	18.83	2.85
		13	487	159.91	6.59	49.64	7.48	19.41	2.72
		14	539	160.37	6.82	52.42	8.92	20.26	3.09
Male	Rural	11	412	148.29	6.75	41.60	8.43	18.81	2.97
		12	470	155.75	8.54	47.26	10.43	19.32	3.10
		13	464	162.69	8.44	53.92	11.53	20.20	3.23
		14	476	167.74	8.92	59.18	12.09	21.04	3.36
	Urban	11	493	148.53	7.32	41.63	8.19	18.77	2.81
		12	495	155.67	8.62	46.71	11.02	19.23	3.38
		13	477	162.63	8.32	53.45	11.24	20.09	3.26
		14	488	168.70	8.30	59.00	11.76	20.71	3.11

Note.—Data are divided for living environment, age, and sex. The number of each group is also reported. Range is min., max.

suggested by Pokos (2002) and Tsimeas, *et al*. (2005); i.e., a town of 10,000 or more inhabitants was considered urban, and less than 10,000 as rural (Tsimeas, *et al*., 2005).

Students also were grouped by sex and age (from 11 to 14 years). Height was measured with a fixed stadiometer to the nearest 0.5 cm and weight was measured with a beam balance to the nearest 0.2 kg.

Only students who self-declared as sedentary were included in the sample, in order to obtain a group with a fitness level not influenced by formal sport practice or hobbies. Students with disability conditions were also assessed for a study of disadvantaged students, which will be developed and published elsewhere.

Measures

Before any assessment, an informed consent was obtained from the parents of the participating students. Electronic data entry by the teacher guaranteed anonymity. Several performances were evaluated: (1) lower back flexibility, (2) strength and endurance of abdominal muscles, and (3) explosive lower limb strength. In particular, these included sit-and-reach, sit-ups, and standing broad jump.

Sit-and-reach.—The sit-and-reach test was used to assess flexibility of the spine and the posterior leg muscles. Each participant was asked to sit on the gymnasium floor, with straight knees, resting his bare feet vertically (separated by 15 cm) against a 30-cm high box. To perform the test, the participant had to lean forward with straight arms and knees and had to reach over the top surface of the box. The distance between toes and fingers was measured. Positive values were recorded if the participant was able to reach further than his toes, negative values were recorded if the participant was unable to reach his toes, and a zero value was given when the participant just touched his toes.

Sit-ups.—The maximum number of sit-ups achieved in 30 sec. was recorded. The participants were instructed to keep their fingers interlocked behind the head while curling up to a sitting position until their body was vertical, then return to the floor. This test assesses abdominal strength and endurance. One trial was evaluated.

Standing broad jump.—The standing broad jump test defines the maximum horizontal distance attained with feet together. The best of two attempts was considered as the final score.

Tests were selected and collected following the Eurofit battery protocol (Council of Europe, 1998) since all variables are strictly defined. This battery ensures simple administration, high practicability in school setting, reliability, and well-defined measurement criteria (Kemper & Van Mechelen, 1996). In particular, these measurements evaluate different

physical performances, without interference between tests, to define the skills progression (Council of Europe, 1998).

Procedure

Data were collected during the entire month of October 2011 by physical education (PE) teachers during curricular PE classes, after the teachers were given specific task training. For comparability, testing conditions were as identical as possible to Eurofit instructions (Council of Europe, 1998). All data were recorded with the same formatted spreadsheet both in Italy and Croatia.

Analysis

Descriptive statistics are expressed as means and standard deviations for all variables (tests and anthropometric data). Three analyses of variance (4-way ANOVAs) were used to examine the differences by country, living environment, sex, and age (independent variables) with height, weight, and Body Mass Index (BMI) as dependent variables. The effects of the main factors as well as their first level of interactions were taken into account. Only the first level of interactions was considered to avoid overanalysis that would have little practical relevance. Statistical differences were considered significant at $p \leq .05$. All analyses were performed with SPSS Version 12.1.

Results

All descriptive statistics divided by countries, living environment, sex, and age are reported in Tables 1 and 2. Comparisons are listed in Table 3. On average, Croatian boys were taller and heavier than Italian boys, although differences between mean values were only 2.92 cm and 3.51 kg. There were no significant differences among the girls. Mean values in boys were 128–200 cm and in girls 127–186.5 cm. A wide range in body weight was observed, 24–123 kg. On average, BMIs were 18.56–21.88 kg/m^2.

Urban students were taller than same age rural peers with minimal differences in the Italian sample. Urban Croatian girls were (on average) heavier than rural girls, while in Italy the urban girls were smaller. Urban Croatian boys were heavier than rural boys, while the Italian boys' weights and heights followed a nonlinear trend.

Performances on all tests were significantly influenced by age, sex, living environment, and country ($p < .0001$ for all comparisons) in analyses controlled for the effects of anthropometric variables. Age significantly interacted with sex (all three ANOVAs), living environment (sit-and-reach, standing broad jump), and country (standing broad jump, sit-ups). In particular, the standing broad jump test showed incremental improvement with age in all groups. Country significantly interacted with sex in

TABLE 2
DESCRIPTIVE STATISTICS OF MOTOR CHARACTERISTICS OF ITALIAN AND CROATIAN RURAL AND URBAN STUDENT GROUPS

Group, Sex, Living Environment		Age (yr.)	Sit-and-reach (cm)		Standing Broad Jump (cm)		Sit-ups (*n*)	
			M	*SD*	*M*	*SD*	*M*	*SD*
Croatian								
Female	Rural	11	2.93	7.99	148.72	20.54	16.85	3.95
		12	3.38	7.92	156.18	22.06	17.82	4.28
		13	4.31	9.38	160.87	22.78	19.09	4.04
		14	6.74	9.60	164.99	23.30	19.55	5.01
	Urban	11	2.96	7.89	152.43	22.10	18.11	4.53
		12	4.91	7.88	159.98	23.14	19.27	3.99
		13	4.89	8.16	162.98	22.32	20.12	4.29
		14	6.47	8.23	164.65	22.72	20.83	4.47
Male	Rural	11	0.54	7.50	157.79	19.77	18.85	4.29
		12	−0.98	8.02	165.37	23.84	19.96	4.89
		13	−0.30	9.29	178.68	25.08	21.31	4.87
		14	−0.79	9.14	192.47	26.04	23.39	4.98
	Urban	11	−0.45	6.94	161.74	21.63	19.69	4.81
		12	−0.67	7.54	167.01	23.91	21.04	4.61
		13	−0.30	7.24	180.44	23.92	22.65	4.76
		14	−0.54	8.53	191.03	26.23	23.26	4.39
Italian								
Female	Rural	11	6.54	7.25	146.34	23.17	19.31	3.55
		12	6.27	8.48	159.26	23.12	19.71	3.82
		13	6.80	8.47	163.05	25.85	19.32	3.51
		14	5.28	7.48	163.58	23.88	17.69	4.16
	Urban	11	5.41	7.84	147.80	21.49	19.35	3.93
		12	6.61	8.03	152.61	20.97	19.10	4.26
		13	7.64	8.61	156.73	20.77	19.35	4.13
		14	6.48	10.19	157.27	24.76	17.59	4.58
Male	Rural	11	−0.77	7.14	160.75	21.55	20.70	4.33
		12	−1.18	6.69	170.04	22.84	21.50	4.20
		13	−0.73	7.83	184.69	24.73	22.29	3.68
		14	−2.58	7.92	189.13	28.40	22.05	4.64
	Urban	11	0.79	8.11	156.20	20.50	21.39	4.53
		12	0.90	8.42	165.71	22.99	21.25	4.27
		13	0.08	8.89	179.90	24.57	22.78	4.63
		14	2.35	11.25	178.61	32.26	23.29	4.40

Note.—Data are divided for living environment, age, and sex. The number of each group is also reported. Range is min., max.

TABLE 3

FOUR-WAY ANOVAS: DIFFERENCES IN THREE TASK PERFORMANCES (SIT-AND-REACH, STANDING BROAD JUMP, AND SIT-UPS) BY AGE, SEX, LIVING ENVIRONMENT (URBAN, RURAL), AND COUNTRY (ITALY, CROATIA)

Source	Sit-and-reach				Standing Broad Jump				Sit-ups			
	F	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2
Age (A)	7.97	3	<.001	0.002	137.97	3	<.001	0.028	54.52	3	<.001	0.011
Sex (S)	1634.18	1	<.001	0.10	1636.46	1	<.001	0.103	1076.39	1	<.001	0.070
Living environment (L)	24.13	1	<.001	0.002	16.68	1	<.001	0.001	44.18	1	<.001	0.003
Country (C)	51.30	1	<.001	0.003	9.44	1	.002	0.001	8.42	1	.004	0.001
A×S	10.35	3	<.001	0.002	81.19	3	<.001	0.017	28.23	3	<.001	0.006
A×L	11.72	3	<.001	0.002	5.14	3	.001	0.001	1.19	3	.31	0.000
A×C	1.24	3	.29	0.00	5.22	3	.001	0.001	61.34	3	<.001	0.013
S×L	2.51	1	.11	0.00	1.14	1	.29	0.00	0.001	1	.97	0.00
S×C	58.63	1	<.001	0.004	7.26	1	.01	0.001	10.04	1	.002	0.001
L×C	11.05	1	.01	0.001	43.79	1	<.001	0.003	25.15	1	<.001	0.002

Note.—ANOVA test by age, sex, living environment, and countries with height, weight, and BMI. Only the main factors and their first level interactions are reported.

all tests, while living environment did not. Additionally, living environment and country had significant interactions in all three ANOVAs.

On average, the sit-ups test ranged between 16 and 23 complete cycles; this test collected the most homogeneous performance in all groups (*SD* pooled within all groups was about 4), even where poor and alarming results occurred (some Croatian students performed only 3, 4, or 5 complete cycles).

In general, Croatian students achieved better results in the standing broad jump, while Italian students performed better trials in sit-and-reach. Italian girls had equal performances in sit-ups to Croatian girls, and boys' groups were on average very similar in standing broad jump trials. Boys performed more sit-up cycles and longer standing broad jump, while girls achieved better results in the sit-and-reach test. In particular, the sit-and-reach test revealed very poor mean results in boys (max. = 2.35 cm; min. = –2.35 cm).

Discussion

The goal of this study was to assess differences in physical fitness between young people who lived in two different countries of the Northeast Mediterranean area. Additionally, the effect of urban or rural areas was investigated. Age affected all performances (Table 3) in strength, power, and flexibility. This phenomenon was present in both countries and in both living environments. Obviously, a normal growth path induces physiological responses (Sparling, O'Donnell, & Snow, 1998), independent of other conditions. An important criterion for trainers or PE teachers to understand is that the standing broad jump performance is strictly related to standing height: on average, the students jumped distances equal to or about 10 cm larger than their own standing height (Lovecchio, *et al*., 2012).

Students' sex influenced performances. Girls had better mean scores in the sit-and-reach test (Mechakra-Tahiri, Freeman, Haddad, Samson, & Zunzunegui, 2012), especially compared with urban boys. Indeed, as noted by these researchers, this sex effect is larger than national or living environment effects, especially in developed regions. In general, poor results were achieved in the sit-and-reach test, with negative values up to –29 cm. Indeed, in this performance the students showed a low performance if compared with other studies (up to 10 cm, Jürimäe & Saar 2003; Serbescu, Flora, Hantiu, Greene, Laurent Benhamou, & Courteix, 2006; Vaeyens, Malina, Janssens, Van Renterghem, Bourgois, Vrijens, *et al*., 2006; Saygin, Zorba, Karacabey, & Mengutay, 2007; Sauka, *et al*., 2011). Poor sit-and-reach results seem to be due to a poor attitude to stretching exercises among students, in agreement with Tomkinson, *et al*., (2007), who attributed low flexibility in Southern European countries in order to cultural habits.

Living environment showed significant differences for all tests; rural students had poorer performances. As reported by Tsimeas, *et al*. (2005), the correlation between performance and living environment is controversial: U.S. urban children have superior fitness (evaluated with a physical activity questionnaire and a cycle ergometer aerobic power test) compared to those living in rural areas; using the same test reported in this protocol, Polish rural children (aged 11-15 years) were fitter than their urban counterparts. The current results cohered with Ozdiric, *et al*. (2005), who found that children living in rural regions preferred to play soccer (a typical outdoor activity), while children living in urban regions had a tendency to prefer indoor activities. Those authors, moreover, indicated a similar percentage of children who were not involved in any kind of sport activity: 35.1% for urban and 30.6% for rural participants.

Age effects were significant except for living environment (sit-up test) and country (sit-and-reach test) interactions. Sit-up test results were probably similar because this kind of exercise is a common practice in all schools and performed by all students, while sit-and-reach results showed an unclear trend because, in the authors' opinion, a personal approach is the key factor in success of stretching sessions, which students of this age often consider boring. Possibly, stretching practices were diverse and so affected only by sex and age. On the other hand, sex × country interactions showed differences between the two countries, possibly due to cultural or school activities. Indeed, the living environment × country interaction could also be explained according to habitual practices.

Although the statistical analysis found significant interactions (age × sex, age × country, sex × country, and living environment × country) in the sit-up test, the differences among groups were negligible and of no practical significance. Indeed, sit-up practice is common in schools, thus giving a similar performance level in different contexts.

There were performance differences between the two samples (Italy and Croatia). Croatian students obtained a better mean score in the standing broad jump test (performance comparable to outdoor activities and similar to jumps in sport), while Italian students performed better in the sit-and-reach and sit-up tests, which are typical indoor exercises. From the present results, it seems that people living in more developed environments (Das, Pal, & Ghosh, 2008), with availability of different athletic and physical structures, do not always get an adequate amount of physical activity (World Health Organization, 2007). Indeed, in Italy, the most industrialized country of the Mediterranean region with 68% urban population, the fitness performance of urban students was poor: compared to an overall sample-weighted mean z-score across Eurofit test takers, Italy was ranked 22th on 23 European Countries (Tomkinson, *et al*., 2007). Thus, the

association between industrial development, more possibilities for activities, and higher performance was not completely supported. Indeed, the only European meta-analysis for this kind of test (Tomkinson, *et al*., 2007) concluded that economic resources did not play a crucial role in performance levels. On the other hand, it is possible that in those areas where a slower-paced daily rhythm is typical (e.g., Croatia), people often take part in various athletic activities in informal ways. The generally better results of the Croatian students could be explained considering the differences in socio-economic status, although Freitas, *et al*. (2007) reported a weak correlation worldwide between fitness and physical performance or habits (especially PE school activities). Even if living in a rural area promotes more physical work and outdoor activity, the results at least for flexibility and abdominal strength agreed with a recent study (Collins, Al-Nakeeb, Nevill, & Lyons, 2012) where 13- to 14-year-old rural students spent more time at home (data from GPS) with few physical activities. Rural students in this study had poor performances in sit-and-reach and sit-ups, which are primarily indoor activities.

There is no doubt that a great deal of performance depends on genetics, but geographical living area plays an active role in forming a person, despite the data showing that age is the most important factor influencing performance. Other studies have investigated the influence of socio-economic status (SES) on fitness and body fat. Freitas, *et al*. (2007) noted inconsistency in the literature with regard to specific associations between SES and physical activity; physical activity participation differed among Estonians, Belgians, and North Americans. These findings are difficult to generalize across countries, especially when social contexts and economic behaviors are implicated. Carlson, *et al*. (2014) demonstrated that low barriers to activity, street safety, and parents' modeling are important factors to instill an active life style in 12- to 13-year-old students.

The measurement of fitness levels considering rural or urban living environments is a difficult goal, because so many factors are implicated. Genetics, cultural habits, facilities, opportunity, economics, politics, familiar traditions, and social aspects all have some effect (Sallis, *et al*., 1992; Freitas, *et al*., 2007; Malina, *et al*., 2008; Carlson, *et al*., 2014). The results indicated a trend, in that urban students performed the "indoor" tests better than rural students. In general, the largest differences were found between sexes and with increasing age in both groups. Thus, perhaps the differences in performance could be attributed to traditions and sport organizations in each country. In particular, a crucial factor may be the organization of PE classes rather than the number of hours of PE (Tomkinson, *et al*., 2007).

The differences in performance due to living environment, population density, pedestrian safety, socio-economic status, or cultural differ-

ences could be decreased by school PE experience. Homogenous opportunities in PE programs could train students toward an adequate age-related fitness. The current study shows that such "low cost" investment could assist trainers and PE teachers toward a more comprehensive examination of performance. Other factors such as hours of practice, sport background, parents' general education level, and family socio-economic status could be further criteria to investigate.

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