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A Comparative Study on Physical Growth and Nutritional Status between Chakma and Riang Adolescent Boys of Tripura, Northeast India

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Abstract – Background: *Growth and nutritional status is a major public health concern for children and adolescents of developing countries such as India and causes high mortality and morbidity.*

Objective: *To assess the prevalence of malnutrition among Chakma and Riang adolescent boys of North and Dhalai district of Tripura, a Northeastern state of India.*

Method: *A cross-sectional study was carried out among 778 (Chakma 391 nos. and Riang 387 nos.) ethnic adolescent boys aged 8-14 years of North and Dhalai district of Tripura, Northeast India. Height and weight were recorded and the body mass index was calculated. WHO recommended indices of stunting (height-for-age, <-1 and <-2 Z score level), thinness (BMI-forage,<3rd and <5th percentile, WHO, 2007) and overweight (≥85th percentile, WHO, 2007) were used to assess the prevalence of malnutrition.*

Results: *Age specific mean values in height, weight and BMI gradually increased. Ethnic population specific stunting was far different among Chakma boys (32.47%; mild and moderate stunting 25.31% and 7.16% respectively) and Riang boys (40.82%; mild and moderate stunting 29.71% and 11.11% respectively). Age specific mean BMI values ranged from 15.14 kg/m to 18.50 kg/m2 in Chakma boys and 14.98 kg/m2 to 18.39 kg/m2 in Riang boys of 8 to 14 years old.*

Overall prevalence of thinness was higher among Riang boys (24.81%; mild and moderate thinness 19.63% and 5.17% respectively) than Chakma boys (15.6%; mild and moderate thinness 12.79% and 2.81% respectively) and only 4.63% boys (Chakma boys 3.33% and Riang boys 1.3%) are overweight ; there is no record of obesity in this study population (p< 0.05).

Conclusion: *Riang boys (40.82%) are more stunted than Chakma boys (32.48%). Prevalence of stunting was 36.63% in the whole study population. Riang boys (24.80%) also more thin than Chakma boys (15.6%), where overall Thinness were found in 20.18% among tribal adolescent boys of North and Dhalai District of Tripura. Height for age, Weight for age and BMI value in different age group are slightly lower in both the ethnic population than the national (IAP, 2005) and international reference value (WHO, 2007). Overall mean height, weight and BMI were not found to be significantly different between rural Chakma and Riang adolescent boys but different from national and international age-specific variables.*

Keywords: *Chakma; Riang; Stunting; Thinness; BMI; Adolescents; Tripura*

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INTRODUCTION

Human physical growth means growth in the entire size of the body or size achieved by specific parts of the body, which is generally influenced by the interaction of endogenous factors like hormones, genetics and exogenous factors like nutrition, health & hygiene, environment, physical activities etc.[1,4] To study physical growth, health and nutritional status of children would be the excellent measures and their average weights and heights may reflect the average nutritional status of any nation's and its citizens[2]. The growth and nutritional status of children of various tribal and nontribal sections of Indian populations have been assessed. Prevalence of malnutrition continues to be the principal cause of ill-health, growth pattern, premature mortality and morbidity in developing

countries[8]. Nutritional studies have highlighted that prevalence of stunting, thinness is still a major public health problem in Indian populations. Prevalence of under nutrition was high due to immense population size, socioeconomic disparities, illiteracy and inadequate access to basic healthcare facilities[10]. Anthropometry is a non-invasive and inexpensive practical technique of nutritional assessment especially in nutritional and epidemiological investigations [11]. Stunting (low height for age), thinness (low body mass index for age), wasting (low weight for height) and under-weight (low weight for age) are commonly used to assess the nutritional status among children and adolescents[9,11]. Growth and Nutritional status of children and adolescents are markedly unsatisfactory among Indian citizens. The ethnic, genetic and environmental differences of Indian population is well known, but information regarding growth and maturation studies on various ethnic groups of India are almost lacking, which offers unique opportunity for growth studies in various aspects.

OBJECTIVE:

To assess the prevalence of malnutrition and to compare physical growth pattern in Chakma and Riang adolescent boys of North and Dhalai District of Tripura, Northeast India.

METHOD:

A cross-sectional study was carried out among 778 nos (Chakma boys 391 nos. and Riang boys 387 nos.) ethnic adolescent boys aged 8-14 years of North and Dhalai Tripura District, Northeast India. Riangs are the second largest tribal community in the state, has been identified as a 'primitive' [Article 342(1) of the Constitution of India[6] Riangs are one of the important members of the great Mongolian family, the history of migration and movement of the Mongolian people is also largely the history of the Riang. The Chakmas, fourth largest tribes of Tripura, came here years back, though the exact time cannot be found out. Anthropologically the Chakmas are belonging to a branch of Tibeto-Burmese tribe of Mongolian race. Ethnically they belongs to the South East Asian races and through the ages of history, they had been moving to the West from Combodia (Manchuria region) – Thailand (Chiengmai regions) towards Burma and ultimately to the CHT[7].

Of 880 subjects identified in the 8-14 years age group, 102 nos (54 Chakma boys; 48 Riang boys) were excluded due to their inappropriate age, absence or unwillingness to participate in the study. The final sample size comprising 391 Chakma boys and 387 Riang boys was included using the Random sampling method. Ages of subjects were recorded from school records and subsequently verified from their birth certificates and official documents. A structured schedule was utilized to obtain the necessary data on their Age, Sex, Family income, Parent's education, Parent's occupation, Family size, Sanitation condition, Source of Drinking water, Community facilities and Physical activities. Subjects of present study mostly belong to the agricultural and manual and/or skilled labour group family background. Modified scale of Kuppuswamy was utilized to ascertain the socioeconomic status of the children. Based on above-mentioned scale, subjects belonged to the lower to middle socioeconomic group. Present investigation was done by conducting household surveys and school visits. Anthropometric and socioeconomic data were collected from May, 2010 to August, 2012 from different School of North and Dhalai Tripura District. Permission was obtained from the Inspector of schools, Incharge of the School and the village level authorities prior to conducting the investigation. Prior to obtaining data verbal consent was also taken from each subject and their parents. All individuals were free from any physical deformities or surgical history and were not suffering from any systemic diseases at the time of data collection. Investigation was conducted in accordance with the ethical guidelines of human experiments as laid down in the Helsinki Declaration[17].

COLLECTION OF ANTHROPOMETRIC DATA:

Using standard procedures heights and weights were recorded[18]. Height was taken with the help of an anthropometer (GPM Swiss made) to the nearest 0.1 cm. Subject stood erect and head was oriented in the Frankfort horizontal plane. Weight was recorded to the nearest 0.1 kg using the portable weighing machine (Libra) with subjects wearing minimum clothing. Body mass index (BMI) was calculated using the standard equation[11]; BMI (kg/m) = weight (kg)/height (m^2). Technical error of measurement, $TEM=\sqrt{(\Sigma D^2/2N)}$, was calculated following the standard method[19], where D=difference between the measurements in separate occasions, N=number of individuals measured. The corresponding calculated values of intra-observer show that, all the measures are within normal range of errors as mentioned in literatures[26,27].

ASSESSMENT OF NUTRITIONAL STATUS:

Recommended anthropometric indices have been utilized to assess the nutritional status among adolescents[11]. Low height-for-age measures linear growth retardation and primarily reflects chronic undernutrition. Height-for-age <-1 Z score (mild) and <-2 Z score (moderate) of WHO reference values was classified as stunting[11]. Thinness (low BMI-for-age) was assessed by comparing age-specific recommended cut-off values of World Health Organization (WHO, 2007). BMI-for-age <3rd percentile (moderate) and

<5th percentile (mild) of WHO reference values was classified as thinness or wasting[11]. Data was statistically analysed using the Statistical Package for Social Sciences (SPSS, version 17.0) and MS Excel worksheet (2010). Collected anthropometric variables were depicted using descriptive statistics of mean and standard deviation. One-way analysis of variance (ANOVA) was done to assess the mean difference between two ethnic populations and age groups. Chi-square analysis was utilized to assess the differences in overall and age specific prevalence of malnutrition. The differences were considered to be statistically significant at p<0.05 level.

RESULTS:

Age- and ethnic-specific subject distribution, descriptive of height, weight, BMI and prevalence of malrnutrition among the Chakma and Riang adolescent boys is showed in Table 1. Age specific mean values in height, weight and BMI gradually increased. Overall mean height, weight and BMI were not found significantly different between Chakma boys than Riang boys only exception is found in height that shows significant difference at 9, 11 and 12 years of age (t-value 2.03, 2.37 and 1.99 respectively) (Table 1). Ethnic specific differences were not found statistically significant in weight (F value=1.033, P value=0.330, df 1; 777), height (F value=0.079, P value=0.784, df 1; 777) and BMI (F value=0.084, P value=0.777, df 1; 777) using ANOVA (p<0.05). Age specific mean BMI values ranged from 14.41 kg/m to 20.02 kg/m^2 in Chakma boys and 14.06 kg/m^2 to 19.87 kg/m^2 in Riang boys of 6 to 18 years old. Using One way ANOVA, age specific mean differences in weight (F-value=174.08; df 6, 391 and Fvalue=186.24, df 6, 387), height (F-value=276.39; df 6,391 and F-value=293.74; df 6,387) and BMI (F-value=34.78; df 6, 391 and F-value=34.98; df 6, 387) were found to be statistically significant among Chakma boys and Riang boys (p<0.05). Overall prevalence of Stunting (36.63%) was found markedly higher than Thinness (20.18%) and only 2.31% boys are Overweight; there is no record of Obesity in this study population. Ethnic population specific Stunting was far different among Chakma boys i.e., 32.47% (mild stunting 25.31% at -1 Z score and moderate stunting 7.16% at -2 Z score) and Riang boys i.e., 40.82% (mild stunting 29.71% at -1 Z Score and moderate stunting 11.11% at -2 Z Score). Age specific prevalence of mild stunting though did not show any definite age related trend as found 20% to 30.18% in Chakma boys and 23.21% to 35.71% in Riang boys aged 8-14 years of age. Mild stunting was found higher at 12 years age for both the ethnic clans, i.e., Chakma Boys (30.18%) and Riang boys (37.03%) respectively. Similarly moderate stunting was found 3.63% to 10.34% in Chakma boys and 7.01% to 16.36% in Riang boys aged 8-14 years of age. Moderate stunting was found higher among 13 years old Chakma boys (10.34%) and 14 years old Riang boys (16.36%) respectively (Table 2). The age-specific prevalence of stunting was noticeable to some extend higher in adolescent than pre-adolescent age of both the ethnic group. Riang boys are more stunted than Chakma boys of each age group. The ethnic-specific differences in the age-specific prevalence of stunting were found statistically not significant using Chi-square analysis at p<0.05 (Table 3).

Overall prevalence of thinness was higher among Riang boys, i.e., 24.8% (mild thinness 19.63% at 5th percentile and moderate thinness 5.17% at 3rd percentile) than Chakma boys, i.e., 15.6% (mild thinness 12.79% at 5th percentile and moderate thinness 2.81% at 3rd percentile) (p<0.05). Age specific prevalence of thinness did not show any general trend, but prevalence was found to be higher in the age of adolescence (11-14 years). Age specific prevalence of mild thinness was higher among the Chakma boys (15.51%) at age 13 years and among Riang boys (23.21%) at age 11 years. Whereas moderate thinness was higher among Chakma boys (3.77%) at age 11 years and among Riang boys (7.01%) at age 9 years. In this context, age-specific thinness is also higher in adolescent than pre-adolescent age of both the adolescent tribal boys only exception in Riang boys at age 9 years. Riang boys are thinner than Chakma boys age each age group. Age specific difference in thinness among Chakma and Riang boys was not found to be statistically significant using Chi-square analysis (p<0.05) (Table 3). Overall prevalence of overweight was higher among Chakma boys (3.33%) than the Riang boys (1.3%) at ≥85th percentile. Age specific prevalence of overweight was found higher among Chakma boys (7.54%) at age 11 years and among Riang boys (3.63%) at age 10 years. Prevalence of overweight in post-adolescent age was 1% to 3.77% in Chakma boys, whereas in Riang boys there was not a single subject at post-adolescent age showed overweight.

Fig 1 depicts the growth magnitude of Chakma and Riang adolescent boys from 8-14 years and the comparison with Tripuri tribes of Tripura, IAP ref.[23] and nationwide ref. [25] Highest increment in weight was found between 13-14 years (5.36 Kg) followed by 12-13 years (4.67 Kg) in Chakma boys, whereas in Riang boys highest increment was found between 13-14 years (5.09 Kg) followed by 12-13 years (4.72 Kg). The total increment between 8-14 years was 21.5 Kg and 21.16 Kg in Chakma and Riang adolescent boys respectively. The growth magnitude in terms of weight in the study population is almost near to Tripuri tribes of Tripura, but far less from the National reference value.

Fig 2 depicts the growth magnitude in case of height of Chakma and Riang adolescent boys from 8-14 years and the comparison with Tripuri tribes of Tripura, IAP ref.,[23] WHO ref. table[28] and nationwide ref.[25]. Highest increment in height was found between 13-14 years (6.8 cm) followed

by 12-13 years (6.12 cm) in Chakma boys, whereas in Riang boys highest increment was found between 12-13 years (7.1 cm) followed by 13-14 years (6.38 cm). The total increment between 8-14 years was 30.25 cm and 30.42 cm in Chakma and Riang adolescent boys respectively. The growth magnitude in terms of height in the study population is almost near to Tripuri tribes of Tripura, but far less from the National and international reference value.

Fig 3 depicts the growth magnitude in case of BMI of Chakma and Riang adolescent boys from 8-14 years and the comparison with Tripuri tribes of Tripura, IAP ref., WHO ref. charts and nationwide ref. Highest increment in BMI value was found between 9-10 years (0.99) followed by 12-13 years (0.71) in Chakma boys, whereas in Riang boys highest increment was found between 9-10 years (0.71) followed by 13-14 years (0.68). The total increment between 814 years was 3.36 and 3.41 in Chakma and Riang adolescent boys respectively. The growth magnitude in terms of BMI in the study population is better than the Tripuri tribes of Tripura at the age of growth spurt except 9 years of age group, but the BMI value of the study population was below from the National and international reference value.

DISCUSSION:

Prolonged nutritional deprivation during the childhood would be the main cause for prevalence of stunting[11]. The present study showed a high prevalence of stunting among Chakma and Riang adolescent boys probably due to low socioeconomic and demographic conditions, less guidance about health and hygiene, long term nutritional deprivation in their early childhood. Prevalence of undernutrition was found to be greatest among children and adolescents belonging to lower economic groups as compared to higher socioeconomic groups in India[8,13]. Present study has reported overall prevalence of stunting and thinness to be 36.63% and 20.18% among Chakma and Riang ethnic adolescents respectively. Prevalence of stunting was similar to studies reported among adolescents of tea garden worker of Dibrugarh, Assam (45.5%)[13] Medhi et. al.[13] have reported very high prevalence of stunting (50% boys; 43% girls) among adolescents of Assam, Northeast India. Deshmukh et. al.,[8] reported high prevalence of stunting (50.7%) from rural Wardha. A lower prevalence of stunting was reported by Sil et al. (7.67%)[24] in tripuri tribal boys of Tripura, moderate prevalence of stunting was reported by Anand et. al. (38.5%)[20], Malhotra and Passi (29.7%)[21] in North India. Prevalence of thinness was found to be significantly ($p<0.05$) lower than the reported studies among Indian adolescents. Prevalence of thinness was found to be higher in the early age groups (10-13 years), but decreased with age. A similar trend has been reported among adolescents[9,13]. It has also been observed that adolescent boys were more sufferers than girls (59.4% versus 41.3%) in Assam[13]. Rao et. al.[12] utilizing the NNMB data had reported the prevalence of severe thinness among tribal adolescent boys (63%) and girls (42%) among nine Indian states. A moderate prevalence of thinness among adolescents has been reported in North India (30.6%)[21], Sonowal Kachari tribal Assam (25.99%), Paschim Medinipur, West Bengal (20.23%)[15], Agartala, Tripura (17.81%)[24].

CONCLUSION:

The present investigation showed that the rural Chakma and Riang adolescents are facing a great risk in terms of nutritional stress (e.g. stunting) which is more pronounced in both the ethnic group. As the most rural tribal peoples live in the forest and hill tracts without modern healthcare and transport facilities, so they are deprive of proper health care and sanitation.

Poverty, illiteracy is also a major cause of their poor nutritional and growth status. The magnitude of stunting is considered to be still a major problem than thinness. The poor nutritional status among adolescents has important implications in terms of physical work capacity, social and physiological works specially effect in their reproductive outcomes[11,20].

Valuable health and nutritional promotional programs can be initiated on the basis of the research findings with ultimate objective to decrease the under nutrition or malnutrition among rural Chakma and Riang adolescents.

TABLE AND FIGURE:

Table 1: Statistical constants of weight, height and BMI among Chakma and Riang adolescent boys of North and Dhalai district of Tripura

Age Group	No. of students		Mean Weight(Kg) ± SD		Mean Height(cm) ± SD		Mean BMI (Kg/m^2) ± SD		Test of significance (t value)		
	Chakma Boys	Riang Boys	Chakma Boys	Riang Boys	Chakma Boys	Riang Boys	Chakma Boys	Riang Boys	Weight	Height	BMI
8	55	56	24.79 ± 2.57	23.95 ± 3.26	127.80 ± 4.74	126.19 ± 5.08	15.14 ± 0.85	14.98 ± 1.23	1.50	1.70	0.80
9	56	57	26.70 ± 2.86	25.64 ± 3.14	131.90 ± 5.55	129.91 ± 4.76	15.33 ± 1.12	15.16 ± 1.40	1.88	2.02*	0.72
10	57	55	29.54 ± 4.49	28.10 ± 3.68	134.32 ± 4.37	132.90 ± 4.43	16.32 ± 1.89	15.87 ± 1.51	1.85	1.69	1.40
11	53	56	32.82 ± 5.04	31.15 ± 4.09	139.21 ± 4.56	137.13 ± 4.66	16.88 ± 2.02	16.52 ± 1.60	1.92	2.37*	1.05
12	53	55	36.26 ± 5.21	35.30 ± 5.16	145.13 ± 5.44	143.13 ± 4.95	17.15 ± 1.69	17.18 ± 1.88	0.96	1.99*	0.90
13	58	53	40.93 ± 4.88	40.02 ± 4.69	151.25 ± 5.45	150.23 ± 4.79	17.86 ± 1.57	17.71 ± 1.70	1.01	1.01	0.48
14	59	55	46.29 ± 5.29	45.11 ± 5.21	158.05 ± 4.59	156.61 ± 4.97	18.50 ± 1.65	18.39 ± 1.94	1.20	1.60	0.33

*Significant at p-value<0.05

Table 2: Nutritional status of Chakma and Riang tribal boys of North and Dhalai District of Tripura

Age Group (in years)	Stunting (Z Score, WHO, 2007)				Thinness (Percentile, WHO, 2007)				Overweight (Percentile, WHO, 2007)	
	<-1		<-2		<3rd		<5th		≥85th	
	C	R	C	R	C	R	C	R	C	R
8	11 (20)	13 (23.21)	2 (3.63)	5 (8.92)	1 (1.81)	2 (3.57)	3 (5.45)	11 (18.96)	0	1 (1.78)
9	13 (23.21)	16 (28.57)	2 (3.57)	4 (7.01)	2 (3.57)	4 (7.01)	7 (12.5)	10 (17.54)	0	1 (1.75)
10	14 (24.56)	15 (27.27)	4 (7.01)	7 (12.72)	1 (1.75)	2 (3.63)	7 (12.25)	10 (18.18)	4 (7.01)	2 (3.63)
11	15 (28.30)	20 (35.71)	4 (7.54)	8 (14.28)	2 (3.77)	3 (5.35)	8 (15.09)	13 (23.21)	4 (7.54)	1 (1.78)
12	16 (30.18)	19 (34.54)	4 (7.54)	7 (12.72)	1 (1.88)	3 (5.45)	7 (13.20)	10 (18.18)	2 (3.77)	0
13	16 (27.58)	16 (30.18))	6 (10.34)	8 (15.09)	2 (3.44)	3 (5.66)	9 (15.51)	10 (18.86)	2 (3.44)	0
14	14 (23.72)	16 (29.09)	6 (10.16)	9 (16.36)	2 (3.38)	3 (5.45)	9 (15.25)	12 (21.81)	1 (1.69)	0
Total	99 (25.31)	115 (29.71)	28 (7.16)	43 (11.11)	11 (2.81)	20 (5.17)	50 (12.79)	76 (19.63)	13 (3.33)	5 (1.3)

*Figures mentioned in parentheses are percentage ; C-Chakma boys, R-Riang boys

Table 3: Changes in age-specific prevalence of stunting, thinness and overweight in the Chakma and Riang adolescent boys of North and Dhalai district of Tripura using WHO growth reference (WHO, 2007)

Age (in years)	Stunting		Thinness		Overweight	
	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value
8	0.582 (0.044*)	1.000 (0.833)	0.01 (0.12)	1.000 (0.730)	-	-
9	2.344 (0.036)	1.000 (0.849)	0.008 (0.307)	1.000 (0.579)	-	-
10	1.185 (0.016)	1.000 (0.901)	0.063 (0.278)	1.000 (0.598)	0.007 (0.02)	0.934 (0.888)
11	1.72 (0.035)	1.000 (0.852)	0.399 (0.291)	1.000 (0.589)	0.015 (0.01)	0.902 (0.920)
12	1.907 (0.043)	1.000 (0.836)	0.363 (0.238)	1.000 (0.625)	-	-
13	3.062 (0.057)	1.000 (0.811)	0.048 (0.328)	1.000 (0.567)	-	-
14	1.535 (0.06)	1.000 (0.806)	0.172 (0.353)	1.000 (0.553)	-	-

*Figures mentioned in parentheses are values after Yates Correction

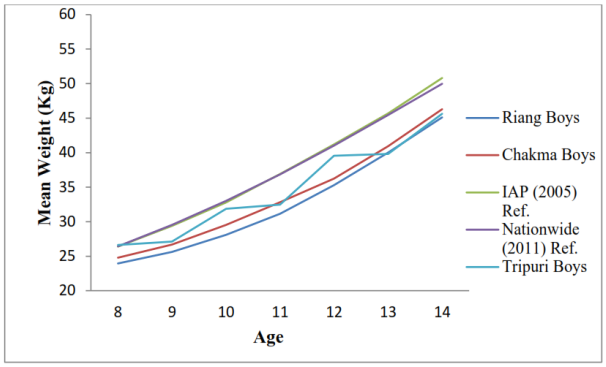

Fig 1: Growth pattern of mean weight of Chakma and Riang adolescent boys of North and Dhalai district of Tripura with comparison to national standards.

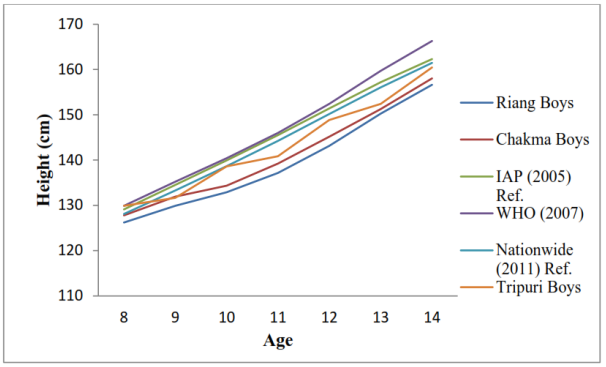

Fig 2: Growth pattern of mean height of Chakma and Riang adolescent boys of North and Dhalai district of Tripura with comparison to national and international standards.

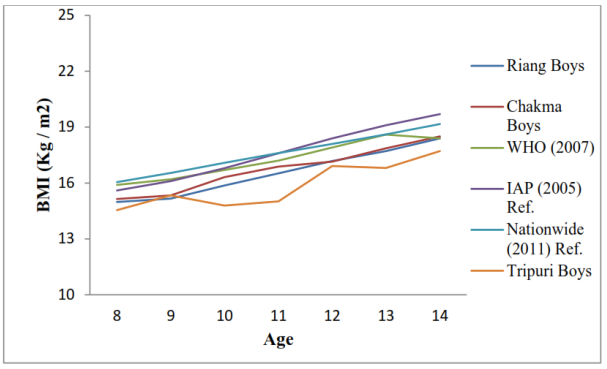

Fig 3: Growth pattern of mean BMI of Chakma and Riang adolescent boys of North and Dhalai district of Tripura with comparison to national and international standards.

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