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ASSESSMENT OF FOOD AND NUTRIENT INTAKE OF PUNJABI FARM WOMEN IN THE CONTEXT OF IRON DEFICIENCY ANEMIA

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ABSTRACT

Sixty non-pregnant and non-lactating adult women in the age group of 25-35 years from the farm families (land holdings between 2-4 ha) were purposively selected from village Ayali Kalan, district Ludhiana, Punjab (India) to assess their food and nutrient intake in the context of iron deficiency anemia. Forty percent of the subjects had their hemoglobin tested and only 3% reported deworming treatment in the last one year. The mean hemoglobin was 10.5 ± 1.18 g dL^{-1}. Eighty three percent of the subjects were anemic out of which 13 and 70% were mildly and moderately anemic. The overall adequacy of cereals, pulses, green leafy vegetables, roots and tubers, fruits, other vegetables, milk and milk products, sugars and fats & oils in the diets of farm women was 98, 54, 5, 63, 49, 16, 122, 141 and 216%, respectively. Of the 7 nutrients studied, calcium was found adequate while energy, protein, folate, ascorbic acid and iron were marginally adequate with nutrient adequacy ratios of 75-100%. Only β-carotene was marginally inadequate. The mean adequacy ratio was 83% which gives satisfactory picture of nutritional intake of the farm women. Though the intake of most of the nutrients related to iron nutriture of farm women were marginally adequate, the hematological profile, as revealed by the hemoglobin levels in subjects, showed dismal condition of their iron status.

Key words: Farm women, food intake, hemoglobin, iron deficiency anemia, nutrient intake

INTRODUCTION

The problem of malnutrition in developing countries encompasses a spectrum of deficiencies of which iron deficiency is most devastating. Iron deficiency often leads to the morbidity and ill health, growth retardation, reduced level of development activity in children and low productivity in adults (Arnold *et al*., 2009). Anaemia begins in childhood, worsens during adolescence in girls and gets aggravated during pregnancy and is often associated with adverse pregnancy outcome. About 33% global population is anemic (WHO, 2010). As per the WHO estimates, India has the highest prevalence of anemia amongst the South Asian countries (WHO, 2004). Alarmingly, about 50% global maternal deaths due to anemia occur in South Asian countries of which 80% occur in India alone (Kalaivani 2009).

As per the survey of National Nutrition Monitoring Bureau (NNMB) and National Family Health Survey (NFHS), anemia prevails in 56.2% women in the age group of 15-49 years, 72.2% children of 6-35 months age, 57.9% pregnant women and 24.3% men in age group of 15-49 years (NNMB, 2003; NFHS, 2007). The prevalence seems to be the same in urban and rural areas, but the gender difference exist with higher prevalence in females. Also, the age does not seem to play any important role in consumption patterns.

In India, Punjab state is surplus in food grain production and has abundance of green leafy vegetables production especially in winters. Despite this, iron deficiency continues to be a major nutritional concern which is adversely affecting the work efficiency of women (Bains and Mann, 2000). Regardless of adequate iron consumption, the anemia prevalence is reportedly high which is attributed to the poor availability of dietary iron from traditional Punjabi diets (Bains *et al.,* 2006). As NFHS-3 (2005-06), 38% women in Punjab suffer from iron deficiency anaemia, with 26% having mild anemia, 10% moderate anemia and 2% severe anemia. Anemia is particularly high for young women, scheduled-caste women and women from the lower wealth quintiles. Understanding of food and nutrient intake by farm women is imperative to solve the problem of iron deficiency anemia by giving a right direction to their meal pattern. Endeavour can be made to balance the meals for enhanced iron bioavailability by educating the women regarding quality meals which can play a pivotal role in addressing the problem of iron malnutrition. The present study was aimed to study the health profile as well as food and nutrient intake of Punjabi farm women in the context of iron deficiency anemia.

MATERIALS AND METHODS

The study was conducted during May and June, 2013 in the village Ayali Kalan, which is situated in Ludhiana-1 Mandal, Ludhiana district, Punjab (India). It is 7.7 km away from Mandal Main Town (Ludhiana) and 10.7 km away from main Ludhiana city. The village has a population of 3442 with male and female ratio of 53:47. Sixty non-pregnant and non-lactating adult women in the age group of 25-35 years from the farm families of this village with land holdings between 2 and 4 ha were purposively selected. An interview schedule was developed to collect the general information about the subjects with respect to their age, education, occupation, type of family, family income and number of children, etc. by '24 hour recall method' (Willett, 1998) for 3 consecutive days as well as to assess food intake of the subjects. The major nutrients were calculated using MSU Nutriguide Computer Program (Song *et al.,* 1992). The intake of nutrients i.e. energy, protein, β-carotene, folate, ascorbic acid, iron and calcium in each meal was assessed.

In order to determine the nutrient adequacy of diet, the nutrient adequacy ratios (NAR) were calculated for each of 5 micro-nutrients (β-carotene, folate, ascorbic acid, iron and calcium) and energy and protein. NAR was calculated as the intake of a nutrient divided by the recommended dietary allowance (RDA) for that nutrient (ICMR, 2010). Mean nutrient adequacy ratio (MAR), the mean ratio of intake to recommended intake (each truncated at 100%) of energy, protein and nine micronutrients was calculated as a measure of the adequacy of overall diet. For both NAR and MAR, a value of 100% was considered ideal since it meant that the intake was same as the requirement (Torheim *et al.,* 2004). The NAR and MAR were calculated using the following formulae:

NAR (%) = (Intake of nutrient/Recommended intake of nutrient) x 100

MAR (%) = Sum of each NAR (truncated at 100%)/No. of nutrients

Nutrient adequacy ratios (NAR %) were categorized as per Jood *et al.* (1999) as adequate (100% and above); marginally adequate (75 to 99.9%); marginally inadequate (50 to 74.9%) and inadequate (below 50%).

The haemoglobin (Hb) level of subjects was determined using hemoglobin kit (Becan Diagnostic Pvt. Ltd., Gujarat, India). Blood samples were drawn from the 3rd finger of left hand with a haemoglobin pipette and delivered into a test tube containing 5 mL Drabkin's solution. Haemoglobin is converted to cyanomethaemoglobin containing potassium cyanide and potassium ferricyanide which is measured colorimeterically (Dacie, 1988) and Hb calculated from the standard curve prepared from the standards provided in the kit. The subjects were classified on the basis of their hemoglobin levels into anemia classification of WHO (2011). Mean and standard errors for various parameters studied were computed. Analysis of variance was employed and critical difference calculated**.**

RESULTS AND DISCUSSION

The subjects were purposively selected from semi-medium farm families with land holding between 2 and 4 ha. The agriculture was the sole family occupation of 43% of the subjects whereas 30 and 27% subjects reported service and business, respectively, as the additional occupation of their husbands. The monthly family income of < Rs 10,000 were reported by 33% while 37% had income > Rs. 20,000. The average monthly family income was Rs. 15,958. The findings showed that the selected subjects belonged to the families with modest income and limited purchasing power. The subjects were in the age category of 25-35 years with mean age of 31.3 years. About 30% subjects were educated up to matric level while 40 and 30% were educated up to intermediate and graduate level. Majority of the subjects (83%) were housewives and 60% had joint families. About 50% women had two or less children whereas 40% had 3-4 children and hardly 17% were non-vegetarians.

Health profile

During survey 73% subjects reported no episode of disease in the last 6 months (Table 1). Bains *et al.* (2012) reported that 49.4% farm women showed morbidity during last 6 months. A better health status of farm women may be the reason for low morbidity in the present study as ~67% women reportedly followed the practice of regular medical checkup. This indicated that most subjects were aware of health services available to them. Contrary to this, only 20% subject used to modify their diet during an episode of illness reflecting the lack of nutrition-related information. Further, 20% subjects used to take various dietary supplements, out of which 58% used to take multi-mineral supplements including iron thereby indicating a dire need of nutrition education to the rural women. Forty percent of the subjects had their hemoglobin tested, out of which 42% reported a recent testing of hemoglobin for less than three months. Awareness regarding deworming was negligible as only 3% reported deworming treatment in the last one year. Intestinal worms infect one in four people worldwide, particularly being prevalent in developing countries (Awasthi *et al*., 2000). High prevalence of anemia is strongly associated with intestinal worm infestations and deworming has been proven as effective strategy along with iron supplementation to control anemia (Casey *et al*., 2009). The hemoglobin of the subjects ranged between 8.3 and 12.4 g dL^{-1} with a mean value of 10.5 ± 1.18 g dL^{-1}. The mean Hb was unsatisfactory when compared with the reference value of 12 g dL^{-1} (WHO, 2011). Bains *et al.* (2012) found the mean blood hemoglobin level in rural women to be 10.4 g dl^{-1} with anaemia prevalence of 50.6%. The data in the present study reveals a dismal picture of iron status in farm women. As per NNMB (2006) and NFHS-2 (1998-1999) data, 75.1% women in the age group of 20-49 years were anemic. As per WHO categorization, 83% subjects were found anemic, of which 13 and 70% were mildly and moderately anemic, respectively (Fig. 1). Severe degree of anemia (Hb <8.0 g dL^{-1}) was not prevalent in the studied

Table 1: Health profile of adult women from farm families [N = 60]

Particular	No.	%
1. Episode of disease in last 6 months		
Yes	16	27
No	44	73
2. Regularity in medical check-up		
Yes	20	33
No	40	67
3. Modification in diet during illness		
Yes	12	20
No	48	80
4. Dietary supplement used		
Yes	12	20
No	48	80
5. Type of dietary supplementation used		
Multivitamin	2	3
Multi-minerals including iron	7	12
Any specific vitamin or mineral	3	5
6. Hemoglobin tested		
Yes	24	40
No	36	60
7. Time of hemoglobin tested		
<3 months	10	17
>3 months	14	23
8. Blood hemoglobin level (g dL^{-1})		
Range	8.3- 12.4	
Mean ± SD	10.5±1.18	
9. Deworming treatment in last one year		
Yes	2	03
No	58	97

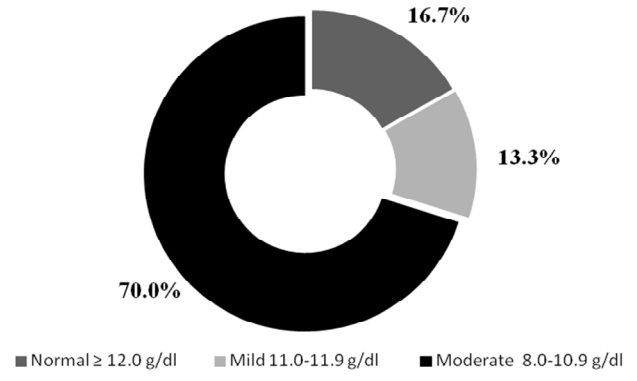

Fig. 1: Categorization of farm women in Punjab as per WHO (2011) classification of iron deficiency anemia

group; however the incidence of moderate anemia was very high. Bains and Mann (2000) have reported that moderate anemia significantly reduced the physical fitness of young Punjabi women. Bains *et al.* (2006, 2012) tested the hemoglobin level in Punjabi women at the end of winter season and found less prevalence of anemia (47-51%) whereas mild, moderate and severe anaemia in later study was found to be 26.0. 22.4 and 2.2%, respectively. The results confirmed that the hemoglobin level of Punjabi women dips after summers, mainly attributed to the lesser availability of greens during summer season.

Awareness of iron deficiency anemia

The present survey revealed that the majority (70%) of farm women were not aware iron related deficiency anemia and role of diet in its prevention. Of the aware women, 73% knew that diet has a role on the occurrence and prevention of anemia, however they did not know the ways to prevent iron deficiency anemia through dietary approach. Previous studies have revealed that women folk have little information on iron deficiency anaemia and nutrition education to them resulted in significant improvement in their knowledge about anaemia (Kaur, 2006; Malhotra, 2002).

Food intake

The daily intake of various foods and percent food adequacy of the subjects revealed that the daily intake of cereals was 98% of the suggested intake of ICMR (2003). The intake of cereals was significantly higher in dinner than at lunch (Table 2; Fig. 2). Pulses and legumes were inadequate as compared to the suggested level. The pulses were mainly consumed during dinner. The intake of pulses and legumes during break-fast and in-between meals was very less. Our results are close to Bains *et al.* (2006) who reported an average daily per capita consumption of cereals as 360 g among the farm families belonging to the three agro-climatic zones of Punjab. Kaur (2012) reported that the daily average consumption of pulses by the farm women was 32.6 g.

Table 2: Daily food intake (g) of adult women from farm families [N = 60]

Food group	Breakfast	Lunch	Dinner	In-between meals	P value*	$CD_{0.05}$	Total intake	Suggested intake**
Cereals	114 ± 27	110 ± 27	124 ± 8	4 ± 9.0	≤0.01	13.0	352 ± 70	360
Pulses and legumes	3.5 ± 5.7	0.0 ± 0.0	35.8 ± 4.3	1.0 ± 3.1	≤0.01	2.5	40.3 ±13.1	75
Green leafy vegetables	0.3 ± 1.8	4.3 ± 13.3	0.0 ± 0.0	0.0 ± 0.0	ns	-	4.6 ± 15.1	100
Roots and tubers	12.0±14.9	31.0± 22.0	13.0 ± 15.1	6.7 ± 9.6	≤0.01	10.5	62.7± 61.6	100
Other vegetables	8.0 ± 16.3	27.7± 20.1	13.3 ± 22.5	0.0 ± 0.0	≤0.01	11.8	49.0± 58.9	100
Fruits	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	15.7 ± 27.8	-	-	15.7 ±27.8	100
Milk and its products	125 ± 29	30.0 ± 47	107 ± 74	103 ± 13	≤0.01	32.0	365 ± 162	300
Meat, egg and poultry	0.0 ± 0.0	0.0 ± 0.0	8.3 ± 32.4	0.0 ± 0.0	ns	-	8.3 ± 32.4	-
Sugars	16.7 ± 6.1	0.0 ± 0.0	0.0 ± 0.0	25.5 ± 7.3	≤0.01	2.1	42.2 ±13.4	30
Fats and oils	17.7 ± 7.3	16.3 ± 4.9	17.3 ± 5.8	2.7 ± 4.5	ns	-	54.0± 22.5	25

Values are mean±SD; P values are for 3 major meals i.e. breakfast, lunch & dinner; *P value 0.01 = significant at 1%; ns = Non-significant; **Suggested intake for moderately active adult women (ICMR, 2003)

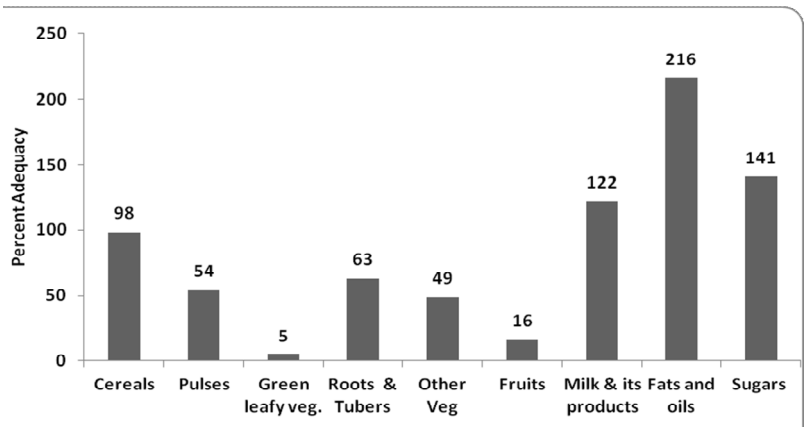

Fig. 2: Percent adequacy of food groups among adult women belonging to farm families

Very low consumption of green leafy vegetables was noticed in the study area which was grossly inadequate with adequacy of only 5%. The poor consumption of green leafy vegetables is a matter of concern especially in this group where majority of subject (83%) are vegetarian. Bains *et al.* (2006) reported an average daily per capita consumption of green leafy vegetables as 85.6 g among the farm families belonging to to the 3 agro-climatic zones of Punjab. Kaur (2012) reported that the daily average consumption of green leafy vegetables by the farm women was 65.4 g. Both the above reported studies were carried out during winters when sufficient supply of iron rich leafy vegetables is available. The results revealed that inadequate leafy vegetable consumption is the major reason for iron deficiency anemia among the studied group.

The consumption of roots, tubers and other vegetables was inadequate and their intake in lunch was significantly higher than the other two meals. Similarly, the daily intake of fruits was grossly inadequate. The fruit consumption was only during in-between meals and none of the subjects used to take fruits in major meals. NNMB survey (1975-2005) reported that the intake of other vegetables was below the suggested levels in almost all the states in India (except Kerala and Orissa), with intake in Karnataka and Andhra Pradesh less than half the suggested level. Indian Nutrition Profile (INP) survey (1995-1996) reported that the intake of other vegetables was adequate in most of the Indian states, except Haryana, Himachal Pradesh, Punjab, Rajasthan and Nagaland. National Family Health Survey-2 (1998-99) reported that fruits were consumed daily by only 8% women and only 33% women consumed fruits at least once a week.

Milk and curd intake by the subjects was higher than the suggested intake. Maximum consumption of milk was in breakfast and least at lunch when they used to take curd. Tea was a major source of milk in in-between meals. Negligible amount of non-vegetarian foods was consumed by the subjects. Most subjects were vegetarian. However, non-vegetarian women did not consume appreciable amounts of these foods. Dietary habits influenced the blood iron status as non-

vegetarian foods like chicken, meat, etc. are high in heam-iron which has been reported to have iron absorption varying between 15-35% (Hurrell and Egli, 2010). Daily consumption of sugars and fats was 1.4 and 2.2 times higher than the suggested intakes, respectively.

Nutrient intake

The nutrient intake of the subjects revealed that daily energy intake was less than the RDA of 2230 kcal for moderately active adult women of farm families (ICMR, 2010). The nutrient adequacy ratio (NAR) for energy was 80.2%. Significant differences in energy intake were observed during breakfast, lunch and dinner with maximum consumption from dinner followed by lunch. Kaur (1999) and Kaur (2012) reported that the average daily energy intake of farm women was 75 and 71% of the RDA, respectively. However, Bains *et al.* (2012) reported the daily energy intake of 1681 kcal by farm women. The mean consumption of energy was marginally adequate and is comparable with the intakes reported in the literature.

The total daily intake of protein was 87% of the RDA. The NAR for protein was marginally adequate. The subjects had significantly higher protein intake in dinner than breakfast and lunch. The higher consumption of protein is attributed to habitual consumption of pulses and legumes in dinner by the surveyed group. Our results are in conformity with Kaur (1999) and Kaur (2012) who found that the average daily intake of protein among adult farm women between 35.7 to 53.6 g with mean intake of 43.3 g. Bains *et al.* (2012) reported the protein intake of 48.6 g in the same group. The nutrient adequacy ratio for β-carotene was 59% which was marginally inadequate as per the classification of Jood *et al.* (1999). Though β carotene content in diets was quite low in the three meals, it was significantly higher in breakfast. Maximum consumption of β-carotene was during in-between meals as subjects reportedly consumed mangoes which were available during the surveyed period. Otherwise, no other β carotene rich fruit or vegetable was available to them. The folate intake was significantly low in breakfast as compared to lunch and dinner. The in-between meals had negligible folate. The NAR for folate was marginally adequate (81%). Kaur (1999) reported that the average daily consumption of folate among farm women ranged from 81.7 to 159.2 µg with mean intake of 114.7 µg. Kaur (2012) reported that the mean intake of folate by the rural women to be 158.5 µg while Bains *et al.* (2012) reported the mean daily folate intake of 72 µg. The lower folate intake in the present study was mainly due to the seasonal difference as the survey was conducted in summer when folate rich vegetables were less available.

The total daily consumption of ascorbic acid was 34 mg. Surprising, this vitamin was uniformly distributed in the 3 meals. The NAR was marginally adequate (85%). Lemonade consumption by the subjects may lead to adequacy of this vitamin, otherwise the vegetables rich in this vitamin were not seasonally available at the survey time. Mann *et al. (*1997) reported a highly significant difference in the intake of ascorbic acid by farm women during summer and winter.

The total daily intake of iron was 18 mg day^{-1} and NAR was 86% which was marginally adequate. There was a significant ($p \leq 0.01$) difference in the iron content of three major meals with highest iron in dinner. Mann *et al.* (1997) also found inadequate iron intake among the farm women.

Table 3: Daily nutrient intake of adult women from farm families [N = 60]

Nutrient	Breakfast	Lunch	Dinner	In between	P-value*	$CD_{0.05}$	Total	RDA**
Energy (kcal)	491 ± 124	527 ± 116	569 ±101	201 ± 94	≤0.01	34	1788 ± 433	2230
Protein (g)	13.5 ± 3.4	15.0 ± 5.6	17.9 ±3.8	1.0 ± 0.8	≤0.01	1.5	48.0 ± 13.6	55
β- carotene (µg)	539 ± 269	356 ± 280	367 ±303	1588±1612	≤0.01	48	2850 ±2464	4800
Folate (µg)	38.2±18.8	60.9± 33.2	63.0 ± 30.9	0.3 ± 0.5	≤0.01	8.8	162.4 ± 83	200
Ascorbic acid (mg)	8.5 ± 6.0	8.3 ± 10.7	8.6 ± 9.0	8.6 ± 5.9	Ns	-	34 ± 31.6	40
Iron (mg)	4.1 ± 1.0	5.00 ± 1.7	6.7 ± 4.0	2.4 ± 1.0	≤0.01	0.7	18.0 ± 7.7	21
Calcium (mg)	245 ± 125	198 ± 158	177 ± 92	38 ±10	≤0.01	42	658 ± 385	600

P values are for three major meals i.e. breakfast, lunch and dinner; *P value 0.01 = significant at 1%; ns = Non- significant; **Recommended Dietary Allowances for moderately active adult women (ICMR 2010)

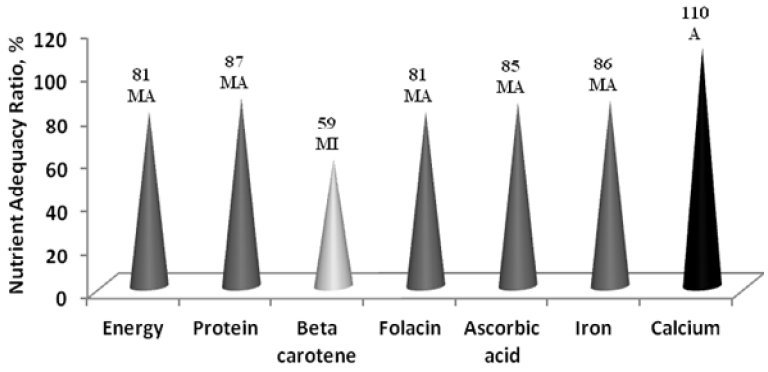

Fig. 3: Percent adequacy of nutrients among adult women belonging to farm families, MA = marginally adequate, A = adequate, MI = marginally inadequate

Kaur (1999) reported mean daily iron intake of 35.4 mg while Kaur (2012) noticed mean iron intake of 14.2 mg in farm women. Bains *et al.* (2012) reported the daily iron consumption of 19.8 mg which was close to the present findings. Though the total intake of iron was marginally adequate, it seemed that the bioavailability of iron from the vegetarian diets of farm women was poor which appears to be the cause of lower hemoglobin levels in farm women. Singh *et al.* (2013) reported that the bioavailability of iron from mixed meals of farm women was poor and green leafy vegetable based meals had bioavailability of 1.49 to 2.13% only.

The breakfast was better source of calcium intake than lunch and dinner, perhaps due to more milk and milk product use in this meal. The total calcium intake was 658 mg day^{-1} which was more than the RDA (ICMR, 2010). Adequate intake of calcium in by Punjabi women may be attributed to the availability of milk and milk products, especially in rural areas where most of the households possess milch animals (Mann *et al*, 1997; Kaur, 1999; Bains *et al* 2012).

The overview of nutrient intake suggested that of the seven nutrients studied, calcium was adequate while energy, protein, folate, ascorbic acid and iron were marginally adequate with NAR values varying between 75 and 100%. Only β-carotene was marginally inadequate. The MAR was 83% indicating satisfactory nutritional intake by farm women. The daily consumption was nearly adequate for cereals by the adult rural women. Milk and milk products, fats and oils, and sugars were adequate while pulses and legumes, all kind of vegetables and fruits were inadequate against suggested intakes. The overview of food consumption highlighted that the diets did not have much of high iron foods. Though the intake of most of the nutrients related to iron status of the farm women were marginally adequate, the hematological profile of the subjects as revealed by their hemoglobin levels showed the dismal condition of their iron status.

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