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Impact of a Social Marketing Campaign Promoting Dark-green Leafy Vegetables and Eggs in Central Java, Indonesia

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Summary: In order to work towards further reduction of vitamin A deficiency in central Java, Indonesia, a social marketing campaign promoting eggs and dark-green leafy vegetables was initiated in March 1996. The nutritional surveillance system (December 1995–December 1996) found the following. The campaign's messages were well noticed. Consumption of at least one egg in the past week increased from 80% to 92% in mothers and from 78% to 92% in children 12–36 months old. It increased in all socio-economic groups and was independent of ownership of chickens. Most eggs had been purchased. The quantity of vegetables prepared increased from 93 to 111 g/person daily and most was purchased. Vitamin A intake increased from 335 to 371 RE/d for mothers and from 130 to 160 RE/d for children. Serum retinol levels increased after the start of the campaign, and were related to egg consumption and vitamin A intake. Because 1. data were collected in such a way that respondents were not aware of the link between data collected and the campaign, and 2. vitamin A status increased and was related to increased consumption of eggs and vitamin A intake, we conclude that the social marketing campaign was successful.

Introduction

Several strategies are being used to work towards reaching the goal of virtual elimination of vitamin A deficiency by the year 2000 set at the World Summit for Children in 1990. This includes the distribution of high-dose vitamin A capsules to groups at risk such as children under 5 years of age and women within a few weeks after delivery, and increasing the availability and consumption of foods naturally rich in vitamin A¹ or fortified with vitamin A.

Indonesia has a long history of combating vitamin A deficiency. Since the early 1970s, high-dose vitamin A capsules have been distributed to children aged 12–59 months, and since 1991 women have been given a high-dose vitamin A capsule within one month after delivery. In addition, the promotion of vitamin A-rich foods has been an essential component of nutrition education [1]. From the mid 1980s, social marketing has been used for promoting both the distri-

¹ It has been agreed internationally that vitamin A intake is expressed in retinol equivalents (RE) and that it is calculated by adding up the vitamin A originating from animal foods, counting 1 µg retinol as 1 RE, and the vitamin A originating from plant foods, counting 6 µg of β-carotene or 12 µg of other provitamin A carotenoids as 1 RE.

bution of high-dose vitamin A capsules and the consumption of vitamin A-rich foods.

While the promotion of vitamin A-rich foods has emphasized plant foods, a social marketing project in Central Java in 1991–1994 promoted the consumption of eggs. The sole promotion of an animal source of vitamin A was a novel idea. The reasons for this choice were that eggs are a good source of vitamin A, that their availability, acceptance and affordability were reasonable, and that they can be prepared in many different ways. In 1996, UNICEF Indonesia initiated a project in central Java to improve survival of children under 2. One of the strategies used was to increase vitamin A intake by children and their mothers. On the basis of the findings of formative research it was decided to promote eggs as well as dark-green leafy vegetables. The main message spread by the campaign was "One egg and a bowl of vegetables are healthy foods for every day: they will make underfives healthy and clever and stimulate breast milk production".

In order to monitor the impact of the campaign, a nutritional surveillance system was set up. Information was collected to enable changes in knowledge, attitude and practice as well as their impact on vitamin A status and morbidity to be monitored. Until now, only one other social marketing campaign on vitamin A which also evaluated its impact on vitamin A status has been reported [2]. That campaign clearly increased the consumption of ivy gourd in northern Thailand, but its impact on vitamin A status was inconclusive [2].

The social marketing campaign in Central Java started in March 1996 and covered the entire province with a population of more than 30 million people. Data were collected every three months, from December 1995 to December 1996.

Subjects and methods

Subjects and sampling design: In total, five waves (rounds) of data collection were conducted by the nutritional surveillance system (December 1995–January 1996, March–April 1996, June–July 1996, September–October 1996, and December 1996–January 1997). Each wave lasted six weeks and for each wave a new random sample of 7200 households was selected,

using a multi-stage cluster sampling design. Central Java consists of six ecological zones. From each zone, 30 villages were selected by probability-proportional-to-size sampling. Each village provided a list of households with a child ≤ 36 months old. From this list, 40 households were selected by interval sampling, using a random start.

A subsample of all households from six randomly selected villages per zone was selected for blood collection from the mother and her youngest child for measuring blood haemoglobin and serum retinol. For waves 1 and 3, 1100 households with youngest child ≤ 24 months old were selected. For waves 4 and 5, 1440 household with a child < 5 months of age were selected. Written informed consent was obtained before blood collection. This procedure had been approved by the Medical Ethical Committee of the Indonesian Ministry of Health.

Data collection: coverage and quality control: Data were collected from almost all (98–100%) of the households selected for each wave. For waves 1, 3, 4 and 5, blood was collected from 35, 57, 73 and 75%, respectively, of the mothers in the selected households and from 31, 39, 70 and 72%, respectively, of the target children in the selected households. The increase in the proportion of subjects from whom blood was collected coverage was attributable largely to the increasing ability of the blood collection team to gain the confidence of and cooperation from the community.

Data were collected by a total of 40 enumerators who were graduates from Indonesian schools of dietetics. Each team of four was supervised by one field supervisor. For quality control, each team revisited 10% of the households visited by another team. After data entry, the performance of each enumerator was evaluated by comparing the data with the quality control data. This was discussed in the refresher training organized before each new wave of data collection, in order to optimize the enumerators' performance.

Methods for data collection

General questionnaire: The general questionnaire collected information on household composition, educational background of husband and wife, occupation of the main earner, sanitary conditions, land owned, food produced, livestock owned, knowledge of vitamin A and the source of such knowledge, source of eggs, source and consumption of vegetables, and use of oil and coconuts. In addition, anthropometric measurements were taken and data on vitamin A intake, receipt of a vitamin A capsule, egg consumption and morbidity were collected from the woman and her youngest child.

Source of information about vitamin A: Respondents were asked whether they had heard about vitamin A and, if so, by which means or from whom. The latter was an open question, the answers to which were coded into pre-set categories.

Egg and vegetable consumption: The following question was asked about egg consumption: "When did you last consume an egg: within the past 24 h, 1–3 days ago, 4–7 days ago, over a week ago, or never?". Questions about vegetable consumption were as follows: "Did you prepare any vegetables in the

past three days? If yes, indicate how much (kg) was prepared from each source (purchase, garden, gift, exchange, gathering, other)." From this answer, the amount prepared per household member per day in the previous three days was calculated, with children < 6 years old regarded as counting 50% of that of adults.

Vitamin A intake: A 24-h recall method was used to enquire about food consumption by the mother and her youngest child. All foods containing vitamin A were classified into five categories: high-vitamin A animal foods (> 250 RE/100 g), low-vitamin A animal foods (< 250 RE/100 g), high-vitamin A plant foods (> 250 RE/100 g), medium-vitamin A plant foods (50–250 RE/100 g), and low-vitamin A plant foods (< 50 RE/100 g). The vitamin A content was derived from Indonesian food composition tables [3–5]. In addition to categorizing foods consumed on the basis of their vitamin A content, information was also collected on serving size: small (< 25 g), medium (25–75 g) or large (> 75 g). Enumerators were supplied with a list of foods included in each of the categories and a list of household measures of foods equal to 50 g. For calculating vitamin A intake, vitamin A contents of the categories (RE/100 g) were set at 600 for high- and 150 for low-vitamin A animal foods, and at 600, 150 and 25 for high-, medium- and low-vitamin A vegetable foods, respectively. The sizes of the three portions, small, medium and large, were set at 20, 50 and 100 g, respectively.

Biochemical parameters: Between 08:00 and 12:00, blood samples were drawn, from an antecubital vein of mothers (3 ml), from the finger tip of children (200–250 µl) in waves 1, 3 and 4 and from an antecubital vein of children (3 ml) in wave 5. Haemoglobin was determined immediately with a portable instrument (Hemocue; Angelholm, Sweden). The remaining blood was centrifuged and the serum separated and transferred to two containers. The containers were stored in the dark in a portable refrigerator powered by a car's battery for a maximum of two days. The serum was then stored at –20 °C in the laboratory of Diponegoro University in Semarang until analysis of retinol at the Nutrition Research and Development Centre in Bogor. Retinol analysis was done within 3 months of blood collection by HPLC (column: Bondapak C18, Waters, Milford, MA; detector for samples of waves 1–4: Shimadzu SPD-6AV, Tokyo, Japan; detector for samples of wave 5: Waters LCM1+; standards: Sigma; solvent: Merck, Darmstadt, Germany) with methanol/water (90:10 v/v) as mobile phase ([6] for samples of waves 1–4, [7] for samples of wave 5).

Data selected for analysis: The purpose of analysis was to identify changes between the waves of data collection that could be related to the campaign, i. e. respondents' sources of information about vitamin A, consumption of eggs and vegetables, vitamin A intake and vitamin A status, and the relationships among these factors. Households from which data were included in the analyses were those for which a complete set of data was available for the variables analysed (i. e. indicators of the factors mentioned above, and ownership of a home garden, oil consumption, receipt of a vitamin A capsule by both mother and child, ownership of a latrine, parental level of educational, and breast-feeding status), except for the question

about the source of eggs consumed because of many missing data (total $n = 9668$). Households with an exclusively breast-fed child were excluded because food consumption patterns of the child, and possibly also of the mother, would be different from the other households. A separate set of data was created for analyses pertaining to serum retinol. In addition to having data on serum retinol levels, selection was based on the same set of variables, except for the source of information about vitamin A.

After exclusion of subjects with incomplete data sets, the following proportions of subjects were available for rounds 1, 2, 3, 4 and 5: for the large data set, 74, 81, 67, 67 and 67%, respectively; for the data set related to mother's serum retinol (wave 2 excluded), 76, 75, 75 and 78%, respectively; and for the data set related to children's serum retinol (wave 2 excluded), 85, 76, 76, and 78%, respectively. The proportion of subjects included was similar for each data set. Therefore, it is not likely that a difference between waves was due to a difference in selection of subjects between waves.

Statistics: Differences among waves were tested with the χ^2 -test for categorical variables, with analysis of variance (ANOVA) for continuous variables for which the histogram of observations showed a normal distribution, and with the Kruskal-Wallis test for continuous variables for which the histogram did not show a normal distribution [8]. When ANOVA or Kruskal-Wallis tests were significant, groups were compared one by one, using Bonferroni's correction for multiple comparisons or the Mann-Whitney test, respectively.

A P value < 0.05 was considered significant. All analyses were conducted with SPSS for Windows version 7.5 (SPSS, Chicago, IL).

Results

Table I shows the basic characteristics of the respondents of waves 1–5. The average age of the youngest child under 36 months was 17–18 months and ca. 83% of them were still breast-fed. Almost all mothers and fathers had received some education. A home garden was owned by 38% of the households interviewed in wave 1 and by 23–30% in waves 2–5. About 60% owned chicken. Coverage of the six-monthly distribution of high-dose vitamin A capsules was 80–89% among children 12–35 months old.

There was an increase between waves 1 and 5 in the proportion of respondents who reported to have seen or heard messages about vitamin A spread by the social marketing campaign from banners or bill boards, posters, radio, health workers and/or friends (Table II). Radio spots were mainly aired between May and July, which period corresponds with data collection waves 3 and 4.

Table 1: Characteristics of the respondents by round

	Wave 1 (n = 5201)	Wave 2 (n = 5783)	Wave 3 (n = 4852)
Age of mother (y), mean \pm SD	27.4 \pm 5.9	27.5 \pm 5.8	27.4 \pm 5.7
Age of child (mo), mean \pm SD ¹	16.5 \pm 9.2 ^a	16.9 \pm 9.3 ^a	18.1 \pm 9.0 ^b
Breast-feeding (%) ¹	86.0	84.6	82.6
Mother's ² / father's ² education (%)			
None	4.7 / 3.9	4.0 / 2.8	4.3 / 2.6
Primary school	66.2 / 59.3	64.7 / 58.1	62.1 / 57.8
Junior high school	15.1 / 14.9	14.8 / 15.3	16.3 / 15.4
Senior high school	12.5 / 18.8	14.6 / 20.0	15.2 / 20.5
Higher tertiary education	1.4 / 3.1	1.9 / 3.8	2.2 / 3.6
Owning chicken (%) ²			
None	39.3	41.5	40.8
1-5	35.1	36.2	35.4
6-10	15.4	14.9	14.7
11-20	7.2	5.3	6.4
> 20	3.1	2.1	2.7
Owning a home garden (%) ²	37.8	29.9	26.1
Receipt of vitamin A capsule by children 12-35 mo old in distribution month (%) ²	80.3	88.3	81.8

¹ Values with different letter are significantly different (ANOVA, $P < 0.05$, Bonferroni correction for post-hoc multiple comparisons)

² Significant differences between rounds (χ^2 -test, $P < 0.001$)

The campaign promoted egg consumption. Figure 1 shows that the proportion of respondents who consumed the latest egg in the past week increased within 3-4 months after the start of the campaign, from 45% to 64% for children aged 3-11 months, from 78% to 92% for children aged 12-36 months, and from 80% to 92% for mothers. Because the data from waves 3-5 were almost the same, they were combined. The group of children aged 3-11 months who had never eaten an egg decreased from 46% to 29%. Almost none of the children aged < 3 months

had been given eggs and that situation did not change between the waves (data not shown). Because maternal education level is a good indicator of socio-economic status in this population [9], it was used to analyse the relationship between egg consumption and socio-economic status. The proportion of mothers who had consumed an egg in the past week was lower with lower socio-economic status (Figure 2), but egg consumption increased in all socio-economic groups. Additional analyses (not shown) revealed that egg consumption and its increase

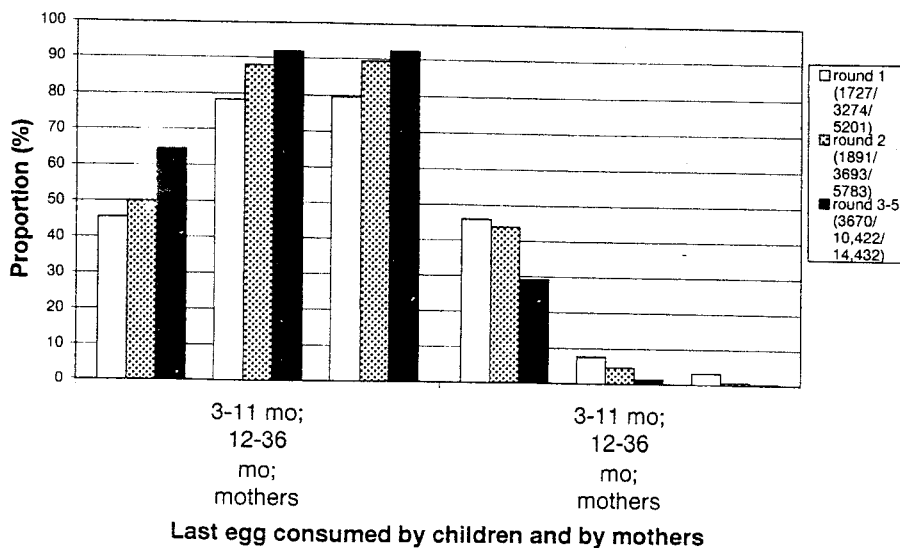


Figure 1: Consumption of latest egg by children and by mothers, by wave. In parenthesis in the legend: the number of children 3-11 months old, children 12-36 months old and mothers, respectively. Note that the category of latest egg consumed more than a week ago is not shown. For all three groups, differences in egg consumption between waves were significant ($P < 0.001$, χ^2 -test).

Table II: Source of information about vitamin A by wave

Source of information from each source ¹ (%)	Wave 1 (n = 5201)	Wave 2 (n = 5783)	Wave 3 (n = 4852)	Wave 4 (n = 4773)	Wave 5 (n = 4807)
Health worker	74.6	80.1	84.5	85.5	78.3
Doctor	29.1	25.6	25.1	23.3	20.3
School	50.4	52.8	56.9	54.7	50.6
Friend	51.3	71.0	71.0	74.5	77.4
Radio	23.2	17.7	32.6	32.0	24.6
Poster	17.9	16.1	23.1	36.8	28.1
Banner / billboard	2.9	1.2	23.8	46.5	39.0

¹ Differences between rounds were significant ($P < 0.001$, χ^2 -test)

were not related to ownership of chickens and that most eggs had been purchased (80% of the households in wave 1 and 73% in wave 5). For households that owned more than five chickens, the proportion of those for whom own production was the primary source of eggs increased from 26% in wave 1 to 41% in wave 5.

The campaign also promoted vegetable consumption. As shown in Figure 3, the amount of vegetables prepared per person per day in the past three days increased between waves 1 and 5. The median increased from 93 to 111 g/day per person. Assuming 20–30% loss after cleaning, the amount consumed thus increased from ca. 65 to 80 g/day. Additional analyses showed that 86–96% of the households had obtained some of the vegetables prepared in the past 3 days by purchasing, while 13–24% had obtained some from the garden (data not shown).

Data on vitamin A intake were collected in all rounds, but those from wave 1 were discarded because the enumerators appeared not yet skilled enough to collect them. Figure 4 shows that mothers' total vitamin A intake increased

between waves 2 and 5. The same pattern was found for children (data not shown). Mothers' median vitamin A intake increased from 335 to 371 RE/d ($P < 0.001$, Mann-Whitney U-test), while that of children increased from 130 to 160 RE/d ($P < 0.001$, Mann-Whitney U-test). The intake of both plant- and animal-derived vitamin A increased (data not shown).

The first part of Table III shows that serum retinol levels of children and mothers were higher after the start of the campaign (waves 3–5) than before (wave 1). The most important question now is whether the increase in vitamin A status was related to changes in food consumption promoted by the social marketing campaign.

Mothers and children who had consumed their latest egg more recently tended to have higher serum retinol levels (second part of Table III). This trend also existed within different categories of education level, reflecting socio-economic status (Table IV). Especially for those with a lower socio-economic status more recent egg consumption was associated with a higher

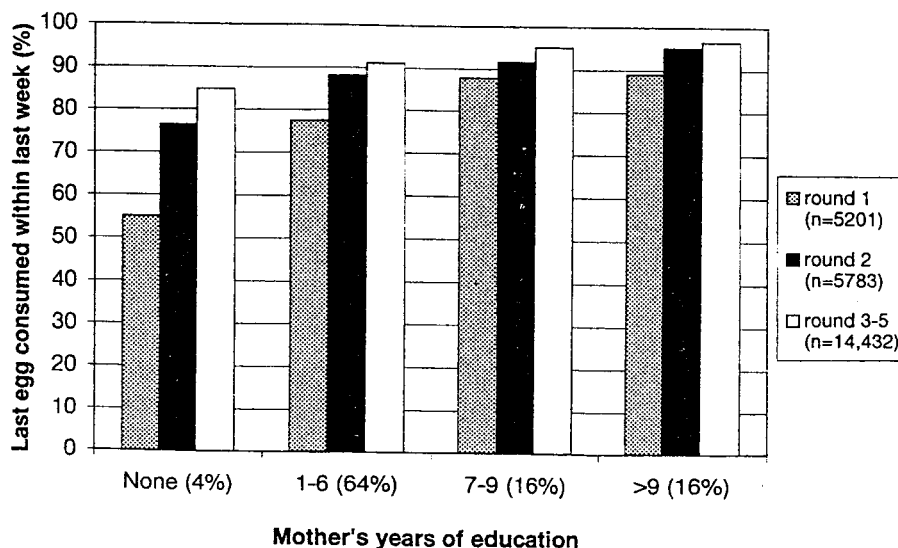


Figure 2: Proportion of mothers who had consumed the latest egg within the past week by education level and by wave. In parenthesis: at the x-axis the approximate proportion within each category (for precise numbers per round, see Table I). Within each category, differences among the rounds were significant ($P < 0.001$, χ^2 -test).

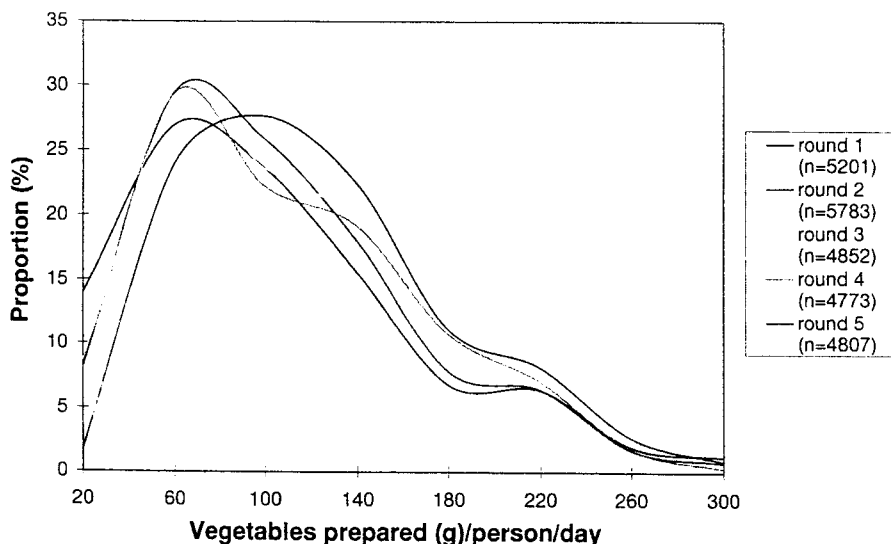


Figure 3: Households' preparation of vegetables in the past three days by wave. Waves with a different letter were significantly different from each other wave: wave 1a, 2b, 3bc, 4c, 5d ($P < 0.001$, Kruskal Wallis test and $P < 0.05$, Mann-Whitney test).

serum retinol level. Children who had received a high-dose vitamin A capsule had a higher serum retinol level than those who had not (0.92 vs. 0.86 $\mu\text{mol/l}$, $P < 0.05$), while the trend of having a higher serum retinol level when the latest egg had been consumed more recently still existed (Table V). The relationship between egg consumption and serum retinol was less clear for the children who had not received a vitamin A capsule.

Because it has previously been reported that plant vitamin A intake should be corrected to ca. 16% because of the lower bioavailability of dietary carotenoids [9, 10], total vitamin A intake was recalculated (animal vitamin A + 16% of vegetable vitamin A) before examining its relationship with serum retinol level. The median of the recalculated vitamin A intake increased be-

tween waves 2 and 5, from 102 to 120 RE/d for mothers ($P < 0.001$, Mann-Whitney U-test) and from 42 to 63 RE/d for children ($P < 0.001$, Mann-Whitney U-test). The last part of Table III shows a dose-response relation between corrected vitamin A intake and serum retinol level, for mothers as well as children.

Discussion

The analyses show that the materials of the social marketing campaign had been noticed and that, for mothers as well as children, the consumption of eggs and vegetables had increased, vitamin A intake increased and serum retinol level increased, and that serum retinol was related to egg consumption as well as vitamin A intake.

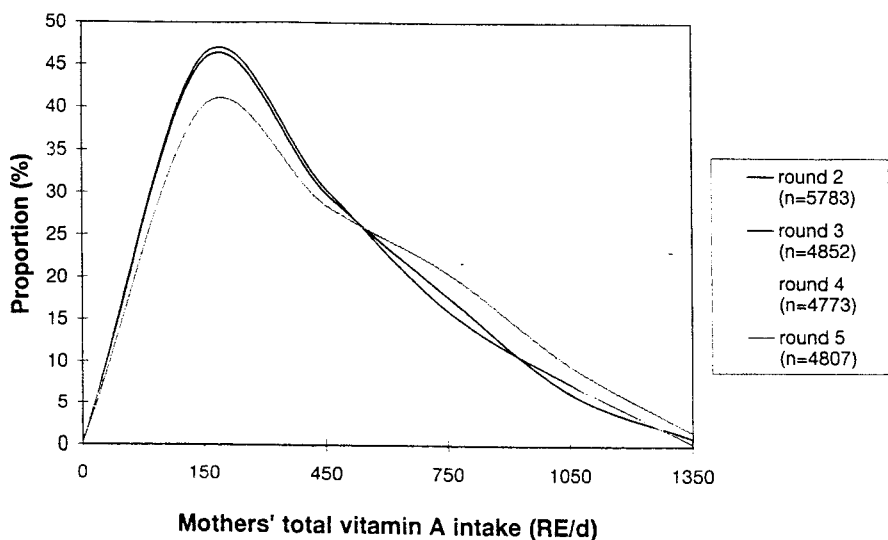


Figure 4: Mothers' total vitamin A intake by wave. Waves with a different letter were significantly different from each other wave: wave 2a, 3a, 4b, 5c ($P < 0.001$, Kruskal Wallis test and $P < 0.05$, Mann-Whitney test).

Table III: Serum retinol level ($\mu\text{mol/l}$) of children 12–23 months old and of mothers by wave, by consumption of the latest egg, and by vitamin A intake¹

	Children 12–23 months old (<i>n</i> = 986)	Mothers (<i>n</i> = 2406)
Waves 1–5		
Wave 1	0.68 [0.63–0.73] (97) a ²	1.08 [1.05–1.12] (296) a ²
Wave 3	0.98 [0.93–1.02] (161) c	1.30 [1.27–1.33] (468) b
Wave 4	0.97 [0.93–1.00] (371) c	1.34 [1.31–1.36] (796) bc
Wave 5	0.87 [0.83–0.90] (357) b	1.37 [1.34–1.40] (846) c
Consumed latest egg		
Never		
> 7 d ago	0.80 [0.67–0.93] (29)	1.06 [0.95–1.18] (26) a ³
4–7 d ago	0.86 [0.79–0.94] (76)	1.24 [1.19–1.29] (217) ab
1–3 d ago	0.87 [0.83–0.91] (212)	1.32 [1.29–1.35] (596) bc
< 24 h ago	0.92 [0.88–0.95] (321)	1.31 [1.28–1.33] (820) bc
	0.93 [0.89–0.96] (348)	1.34 [1.31–1.36] (747) c
Quintiles of corrected Vitamin A intake (RE/d) ⁵ , children / mothers		
≤ 20 / < 52.5	0.86 [0.82–0.91] (211) a ⁴	1.26 [1.23–1.30] (487) a ³
> 20 – < 40 / 52.5–91	0.88 [0.84–0.93] (187) ab	1.29 [1.25–1.32] (475) a
40 – < 70 / > 91 – < 133	0.89 [0.84–0.94] (192) ab	1.33 [1.29–1.36] (468) ab
70 – < 117 / 133 – < 187	0.91 [0.86–0.96] (197) ab	1.30 [1.27–1.33] (471) a
≥ 117 / ≥ 187	0.97 [0.92–1.03] (199) b	1.37 [1.34–1.41] (505) b

¹ mean [95% CI] (*n*)

a,b,c Groups with a different letter were significantly different from each other (ANOVA with Bonferroni correction for post-hoc multiple comparisons)

² ANOVA for differences among the four groups, *P* < 0.001³ ANOVA for differences among the five groups, *P* < 0.001⁴ ANOVA for differences among the five groups, *P* < 0.05⁵ Vitamin A intake recalculated to account for lower bioavailability of vitamin A from plant sources: vitamin A from animal foods + 16% of vitamin A from plant foods (see [9, 10])

Messages were spread using mass media such as radio, banners, billboards and posters, as well as materials for face-to-face communication. Previous campaigns focusing on vitamin A had also used these materials, except for billboards and banners. The sharp increase between waves 2 and 3 in the proportion of respondents who had seen or heard about vitamin A from billboards, banners, radio and posters indicates that the mass media spreading the messages of this campaign had been noticed. The modest increase in messages heard from health workers and friends may have been mediated by face-to-face materials.

Egg consumption increased right after the start of the campaign and was maintained till at least

December 1996. The increase occurred in all socio-economic groups and was independent of ownership of chicken, but the consumption of home-produced eggs was higher in later waves. Because egg consumption increased so rapidly and in all socio-economic groups, we conclude that this was attributable to the campaign.

The amount of vegetables prepared per day increased gradually between waves 1 and 5. The data show that there was very little seasonality in consumption of vegetables. Because vegetables are considered cheap, the increase in their consumption is not likely to be a consequence of a change in price, but rather is attributable to the campaign.

Table IV: Mother's serum retinol level ($\mu\text{mol/l}$) by consumption of latest egg within categories of number of years of education¹

Consumed latest egg	None (<i>n</i> = 122)	1–6 years (<i>n</i> = 1573)	7–9 years (<i>n</i> = 380)	> 9 years (<i>n</i> = 331)
Never	1.00 [–0.21–2.21] (3)	1.05 [0.90–1.20] (16) a	1.15 [0.90–1.39] (4)	1.08 [0.00–2.16] (3)
> 7 d ago	1.19 [1.05–1.32] (26)	1.22 [1.16–1.28] (160) ab	1.41 [1.22–1.60] (17)	1.39 [1.19–1.59] (14)
4–7 d ago	1.23 [1.10–1.37] (35)	1.31 [1.27–1.35] (439) c	1.40 [1.32–1.48] (71)	1.34 [1.24–1.44] (51)
1–3 d ago	1.38 [1.18–1.58] (37)	1.28 [1.25–1.32] (538) bc	1.31 [1.25–1.36] (145)	1.40 [1.24–1.47] (100)
< 24 h ago	1.35 [1.19–1.51] (21)	1.32 [1.28–1.35] (420) c	1.30 [1.23–1.36] (143)	1.42 [1.36–1.49] (163)

¹ mean [95% CI] (*n*)a,b,c Groups with a different letter were significantly different from each other (ANOVA, *P* < 0.01, Bonferroni correction for post-hoc multiple comparisons)

Vitamin A intake increased between waves 2 and 5. If data had been available for wave 1, the observed increase of intake between before and after the start of the campaign might have been larger because the consumption of both eggs as well as vegetables had already increased between waves 1 and 2.

But, before concluding that consumption changed, we should consider whether the respondents' answers reflected the real situation, or that answers were given which respondents thought the enumerators would like to hear. First of all, the enumerators presented themselves as interested in health and nutrition in general, so there was no suggestion of a link between their activities and the social marketing campaign. Secondly, households were never visited twice, thus respondents could not prepare their answers. Thirdly, the questions about food consumption were not posed very directly. For vegetable consumption, respondents were asked whether vegetables had been prepared in the past three days and, if so, how much was purchased, taken from the garden, gathered etc. This information was used to calculate the amount prepared per person per day. For vitamin A intake, a 24 h recall questionnaire was administered, which was afterwards coded for vitamin A intake. The question about consumption of the latest egg was asked amidst questions on health, and the answers obtained suggest that the respondents told the truth. Fourthly, while the various types of information about food consumption was collected in different ways, they all showed the same picture: an increase in egg consumption, an increase in amount of vegetables prepared, an increase in animal vitamin A intake, and an increase in plant-derived vitamin A in-

take. Thus, the campaign seems to have been effective in changing the consumption of both eggs and vegetables.

Serum retinol levels found after the start of the campaign were higher than those before its start. First, we should examine whether the serum retinol levels measured could be compared between the waves, and then we have to examine whether the increase in serum retinol level was due to the campaign.

As mentioned in the subjects and methods section, coverage of blood collection was low in wave 1, better in wave 3 and good in waves 4 and 5. A possible selection bias was most likely towards the better educated who are likely to have higher serum retinol levels. In that case, when vitamin A status did not change and a larger proportion of people with a lower nutritional status were included in later waves, serum retinol levels should have been lower in later waves. Thus, the observed increase in serum retinol levels is likely to be a real increase unless laboratory performance differed across waves. Conditions of transport and storage of samples were the same for all waves. Samples were analysed within a few months after collection. The method used to analyse the samples did not change between waves 1 and 4 and standards used were the same. Therefore, it is unlikely that there was a systematic difference in results obtained for waves 1, 3 and 4. Samples from wave 5 were analysed with a new HPLC system (Waters LCM1 with auto-sampler and a photodiode array detector), for which the method was introduced by the University of Ulster, Coleraine, UK [7]. Standards used were the same as those used for waves 1–4. For mothers, the gradual increase in serum retinol levels seen

Table V: Children's (12–23 mo old) serum retinol level ($\mu\text{mol/l}$) by consumption of latest egg within categories of receipt of a high-dose vitamin A capsule in past 6 months¹

Consumed latest egg	Received vitamin A capsule in past six months ($n = 673$)	Did not receive vitamin A capsule in past six months ($n = 313$)
Never	0.84 [0.62–1.06] (13) ²	0.77 [0.60–0.94] (16) ²
> 7 d ago	0.86 [0.77–0.95] (49)	0.88 [0.72–1.03] (27)
4–7 d ago	0.88 [0.83–0.93] (139)	0.86 [0.79–0.92] (73)
1–3 d ago	0.93 [0.88–0.98] (214)	0.88 [0.82–0.94] (107)
< 24 h ago	0.95 [0.91–0.99] (258)	0.86 [0.79–0.93] (90)

¹ mean [95% CI] (n)

² Differences between groups in one column were not significant (ANOVA)

between waves 3 and 4 was also seen between waves 4 and 5. For children, serum retinol levels were lower in wave 5 than in waves 3 and 4, which may have been due to the change in the way their serum was obtained. Until wave 4, blood was collected from the finger, using capillary tubes ($5 \times 50 \mu\text{l}$) in which it was also stored until centrifugation and separation of serum in the field laboratory. In wave 5, blood was obtained by venipuncture (3 ml) and stored in a covered tube until processing. Blood kept in capillary tubes may have been more subject to evaporation than blood kept in the larger tubes, causing a slight increase in retinol levels in serum of waves 1–4 relative to wave 5. Thus, while serum retinol levels found for children in waves 1–4 may have been slightly exaggerated due to evaporation, serum retinol levels of mothers and children seem to have increased between rounds 1 and 5.

Serum retinol levels were related to egg consumption. For mothers, the relationship was significant and remained when controlled for socio-economic status. For children, the same trend was found and it was also seen when controlled for receipt of a vitamin A capsule. Although not all relationships were significant, the same trends were observed for mothers and children and within their respective subgroups. In addition, because data on egg consumption only concerned consumption of the latest egg, misclassification of some subjects may have reduced the contrast between the groups. Subjects who did not consume eggs very regularly could have been classified in a category of recent egg consumption if they had consumed their latest egg very recently. Thus, it is valid to conclude that there was a positive relationship between egg consumption and serum retinol in mothers as well as in children. A positive relationship was also found between vitamin A intake and serum retinol level both in mothers and in children.

Based on the observations that 1. vitamin A status was higher after the start of the campaign, 2. vitamin A status was related to consumption of eggs and intake of vitamin A, also when controlled for socio-economic status and for receipt of a vitamin A capsule, and 3. consumption of both eggs and vegetables increased after the start of the campaign, we conclude that the campaign

was effective in improving vitamin A status by increasing the consumption of vitamin A-rich foods.

At least half of the success of the campaign in Central Java can be attributed to the promotion of eggs. Before the start of the campaign, the proportions of mothers who had consumed an egg within the past 24 h, 1–3 d ago and 4–7 d ago were as high as 39%, 27% and 14%, respectively, indicating that eggs were already commonly consumed. But the campaign succeeded in increasing consumption even further, especially by reducing the proportion of those who had consumed the latest egg more than a week ago or never.

This is the first social marketing campaign for which an impact on vitamin A status has been documented. Most campaigns have only been evaluated for their impact on knowledge, attitude and practice. The only other documented campaign that evaluated changes in vitamin A status, promoted very successfully the production and consumption of one particular vitamin A-rich vegetable, ivy gourd, but did not find a conclusive result as to an impact on vitamin A status [2].

This evaluation is also an example of how useful a nutritional surveillance system can be for evaluating the impact of a health or nutrition programme. In Bangladesh, the role of the vitamin A capsule distribution programme for combating vitamin A deficiency has been evaluated on the basis of nutritional surveillance data collected in 1990–1994 [11]. In Central Java, nutritional surveillance has been continued in June 1998 to monitor the impact of Indonesia's current economic crisis on household food security, nutritional status and health.

In conclusion, where availability, affordability and acceptance allow, the consumption of animal sources of vitamin A, such as eggs, should be promoted for improving vitamin A status. Egg consumption had an impact on children's vitamin A status in addition to the distribution of high-dose vitamin A capsules. For other groups that are vulnerable to vitamin A deficiency but cannot or do not receive a high-dose vitamin A capsule, such as pregnant women, most of breast-feeding women, adolescent girls and school children, the combined increase in vita-

min A intake from vegetable and animal sources is a realistic way of improving vitamin A status. Where fortified foods can be introduced, they are likely to further increase the effectiveness of a food-based approach.

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