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# Can gossip change nutrition behaviour? Results of a mass media and community-based intervention trial in East Java, Indonesia

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## Abstract

### *Background:*

It is unclear how best to go about improving child feeding practices. We studied the effect of a novel behaviour change intervention, *Gerakan Rumpi Sehat* (the Healthy Gossip Movement), on infant and young child feeding practices in peri-urban Indonesia.

### *Methods:*

The pilot intervention was designed based on the principles of a new behaviour change theory, Behaviour Centred Design. It avoided educational messaging in favour of employing emotional drivers of behaviour change, such as affiliation, nurture and disgust and used television commercials, community activations and house-to-house visits as delivery channels. The evaluation took the form of a 2-arm cluster randomised trial with a non-randomised control arm. One intervention arm received TV only, while the other received TV plus community activations. The intervention components were delivered over a three-month period in 12 villages in each arm, each containing an average of 1300 households. There were two primary outcomes; dietary diversity of complementary food and the provision of unhealthy snacks to children 6-24 months.

### *Results:*

Dietary diversity scores increased by 0.8 points in the arm exposed to TV adverts only (95%CI: 0.4-1.2) and a further 0.2 points in the arm that received both intervention components (95%CI 0.6-1.4). In both intervention arms there were increases in the frequency of vegetable and fruit intake. We found inconsistent evidence of an effect on unhealthy snacking.

### *Conclusion:*

The study suggests that novel theory-driven approaches which employ emotional motivators are capable of having an effect on improving dietary diversity and the regularity of vegetable and fruit intake among children 6-24 months. Mass media can have a measurable effect on nutrition-related behaviour, but these effects are likely to be enhanced through complementary community activations. Changing several behaviours at once remains a challenge.

## Introduction:

Almost a half of all child deaths under the age of 5 are attributable to under-nutrition<sup>1</sup> and world-wide one in four children are stunted.<sup>2</sup> Stunting is a predictor of physical potential, cognitive development and productivity. Faltering in linear growth has been associated with reductions in educational attainment,<sup>3</sup> future earnings and in the likelihood of escaping poverty.<sup>4,5</sup> Stunting is associated with a higher risk of morbidity from infectious diseases such as diarrhoea, acute respiratory infections and malaria<sup>6</sup> and, over the life course, stunted individuals are at greater risk of non-communicable disease.<sup>3</sup> In emerging economies wealth and income are playing a diminishing role in nutritional outcomes, with stunting affecting individuals across wealth quintiles.<sup>2,7</sup>

Investments in nutrition interventions, delivered at scale, have been proven to have measurable effects on infant and child feeding practises.<sup>8</sup> Amongst potential interventions are the promotion of exclusive breast feeding and dietary improvement for children under 2 years. Nutrition programs have largely assumed that inadequate nutrition during the first 1000 days is attributable either to a lack of resources, or to a mother's lack of knowledge. There are several studies showing that knowledge can increase good nutritional practices<sup>9,10</sup> but that knowledge alone is not always sufficient to achieve sustained behavioural change.<sup>11,12</sup> In other areas of public health, practitioners are beginning to move away from health messaging to explore new avenues for changing behaviour such as emotional drivers and norms.

Behaviour Centred Design (BCD) is a new approach to behaviour change which focuses, not on improving knowledge, but on identifying and employing behavioural levers which enable or inhibit change. These levers are typically emotional motivators<sup>13</sup> and ways of overcoming the situational constraints associated with the behavioural setting within which the target behaviour occurs (among other causal factors).<sup>14</sup> A central objective of BCD is to determine a theory of change.<sup>15</sup> This requires that implementation of an intervention causes changes in the environment, which cause psychological changes in target audiences and that these lead to the adoption of new patterns of behaviour. Analysis using the BCD theory of change aims to identify where each change is produced and observe how these cause-effect mechanisms operate. Unlike other popular approaches to behaviour change, BCD has conceptual foundations in evolutionary psychology,<sup>16</sup> reinforcement learning<sup>17</sup> and ecological psychology<sup>18</sup>. BCD employs a design process with five steps A (Assess), B (Build), C (Create) D, (Deliver) and E (Evaluate). BCD has been applied to behaviour change interventions around handwashing<sup>19</sup>, food hygiene<sup>20</sup> and diarrhoea prevention. This is the first application of BCD to infant and young child feeding behaviour.

Indonesia has amongst the highest rates of stunting in the world (35.6%), which is more than double the regional average.<sup>21</sup> Indonesia has long been a test-case for nutritional interventions<sup>22-24</sup>, but substantial, long-lasting change has yet to be realised. The government has typically delivers its nutritional programs through health staff stationed at community-level integrated health posts (*posyandu*). Government programs include growth measurement, the provision health information and materials and nutrient provision. This study was designed to explore whether a systematically designed, theory-driven, scalable intervention could improve infant and young child feeding practices among families of low to middle socio-economic status, in a context where nutrition knowledge is high<sup>25</sup> but the adoption of healthy nutritional behaviours is low. Consequently, this study explored whether a campaign which avoided educational messaging in favour of using strong behavioural levers, could be effective in changing nutritional behaviour. The study also explored which kinds of delivery channels (eg. mass media or community-based activations or a combination of these) were likely to have a greater effect on behaviour.

## Methods:

### *Study Site:*

The intervention took place in Sidoarjo regency (an administrative district) in East Java. Sidoarjo borders Surabaya city, Indonesia's second largest metropolis, and includes many of the city's densely populated sprawling suburbs. Most residents are industrial workers in the city's factories and live with extended families in small houses. The population of this region reflects national rates of stunting and malnutrition.<sup>26</sup>

### *Intervention Design and Delivery*

The intervention was designed, delivered and evaluated according to the five stages of the Behaviour Centred Design (BCD) program development process model: A: Assess, B: Build, C: Create, D: Deliver and E: Evaluate.<sup>14</sup> The Assess step is concerned with defining the project's objectives and then uncovering all relevant knowledge about the target behaviour and target population for the intervention. Build typically involves field-based research that is designed to answer remaining questions about the determinants of behaviour and drafting a theory of change. The Create step involves designing the intervention materials and strategies for delivery. Delivery concerns actual implementation (and the monitoring thereof). During Evaluation, analysis of the project's outcomes and causal pathways from the theory of change takes place. This paper largely concerns the evaluation step.

### Assess

A literature review<sup>27</sup> indicated that in Sidoarjo less than a third of infants are exclusively breastfed at 4 months and the supplementary feeding of formula milk and some solids often begins in the first months of life. Dietary diversity is low and the consumption of unhealthy snacks by children under the age of 2 is common. A framing workshop with key stakeholders identified three key target behaviours: a) improved dietary diversity of complementary food; b) the reduction of unhealthy snacks through the promotion of healthy alternatives; and c) exclusive breastfeeding until 6 months.

### Build

Formative research was undertaken using a variety of methods (such as motive mapping, video ethnography, attribute ranking exercises, inventories of personal belongings, and daily scripts) designed to explore the determinants, the context and the drivers of the target behaviours (methods and results are reported elsewhere<sup>25</sup>). Mothers reported the oft-promoted belief that 'breastfeeding was best' for infants under six months. However, formula milk was consistently ranked 'most healthy' and 'most natural', alongside breastmilk. Mothers also felt that breastmilk was often insufficient in quantity and had to be supplemented with infant formula. Informants associated exclusive breastfeeding with mothers who were unable to pay for formula, and had malnourished babies -- therefore implicitly associating the use of formula with healthy babies. To feed a child formula milk is expensive and requires trips to special shops that sell it. Consequently it is perceived as a status symbol - evidence of the sacrifice a good parent will make for their precious infant. However, formula was rarely prepared correctly or hygienically.

Videos of daily behaviour showed that mothers of toddlers struggled to get children to eat the meals prepared for them. Children were often fed snacks or formula before meals, hence they had little appetite for the mainly rice-based family foods. Since feeding normally takes place in a public street setting, mothers were embarrassed if their child cried and thus fed them snacks to distract them. Hence, though

knowledge of 'correct' nutrition was high, a variety of social and contextual factors conspired to mean that exclusive breast feeding was rare, snacking was high and dietary diversity low.

### Create

A creative brief was developed based on the formative research findings. Social pressure from family members and peers was identified as a key driver of all three target behaviours, hence the brief required that the intervention focus on the affiliation motive<sup>28</sup>. By mapping potential 'touch points' (channels through which the target audience engage with their community and environment) we identified informal womens' groups as a potential mode of delivery for community activations. *Arisans* are an established social structure throughout Indonesia that act as neighbourhood savings and loan systems, but also involve socialising during regular meetings. Formative research indicated that members felt a lot of social pressure to attend *arisan* meetings and so this linked with the chosen motive of affiliation. The creative process was a collaboration between behaviour change theorists, a local creative agency, individuals familiar with the local context and nutrition experts. The intervention package was refined through an iterative process of pre-testing campaign content among target populations.

The concept for the campaign that emerged from the Create process was *Gerakan Rumpi Sehat* (GRS) - The Healthy Gossip Movement. Emblematic of the campaign was the character of *Ibu Rumpi* (Mrs Gossip). We developed three TV adverts (one for each target behaviour) which depicted *Ibu Rumpi* as gossiping about and making judgements on the feeding practices of others before realising, to her great and comic embarrassment, that she was the one who had actually been doing the wrong thing. The theory of change was that the target audience would become more aware of the likelihood that their child feeding practices were being watched and judged by peers, so practicing the wrong behaviour would be embarrassing and damaging to one's reputation. At the same time the community activations set *GRS Arisans* for mothers to practice 'healthy gossip' such that they could support each other to adopt the three behaviours and become better mothers. During *GRS arisan* meetings mothers participated in emotional demonstration activities (emo-demos). Each emo-demo tapped into a behavioural motives (such as disgust, nurture, creativity and curiosity) and used surprise and revaluation to alter the way mothers thought about child feeding.

Educational messaging about nutrition was intentionally avoided. A description of the campaign is given in Table 1 and pictorially in Figure 1. The TV adverts can be seen via the following website:

<http://ehg.lshtm.ac.uk/behavior-centred-design>

### Deliver

The intervention was delivered by three facilitators in each intervention village. The facilitators were responsible for delivering the *GRS arisan* content and conducting house to house visits. The two intervention arms comprised almost 129,000 individuals, of which an estimated four thousand were mothers with children under two and two thousand were pregnant. The three TV adverts were each screened every evening on a local TV station (which we knew to have a viewer base of only about 30% of the population). The TV adverts and community activations were delivered simultaneously over the course of three months..

### Evaluate

The results of the impact evaluation are detailed below. A separate process evaluation was conducted (reported elsewhere).

The impact of the intervention was evaluated in a two-arm cluster randomised trial, with a third non-randomised control arm. Intervention arm 1 was allocated to receive the TV commercials and the community activities. Intervention arm 2 was allocated to receive the TV commercials alone. The control group was unexposed. Since the intervention utilised a provincial television station, the control group had to be selected from a site outside of East Java and so could not be randomised alongside the two other trial arms. Kudus regency, in Central Java, was identified as being the most demographically and nutritionally similar to Sidoarjo. The design allowed us to compare the effects of TV alone and TV plus community activations on the target behaviours.

Clusters were selected through a multi-step sampling process. Firstly, four sub-districts were selected in Sidoarjo. These were purposively selected to be geographically diverse. Administrative villages were selected at random from a sampling frame of administrative villages in each of these four sub-districts. Inclusion criteria were that villages should have populations of between 2,000 - 10,000 people and should not be neighbouring. Twelve villages in Sidoarjo Regency were randomly assigned to intervention arm one: (community activation + television adverts), and 12 to intervention arm two (television adverts only). Six administrative villages were also selected from Kudus (control arm) using the same multi-step sampling process as the other two arms.

Eligible participants were mothers or primary caregivers of children under 2 years of age. Stratified random sampling was used to identify participants in baseline and follow up surveys following the Extended Program on Immunization (EPI) method, which is widely validated for the identification of children under two.<sup>29</sup> A pen was spun in a central location in of each village and enumerators then moved house-to-house to identify eligible participants. Data was collected at the same time in all study arms to minimise the effect of food seasonality.

To account for varying exposure to the television station (which reached only 30% of the population), participants in both intervention arms were screened at baseline for their exposure to the provincial television station (50% of the sample were exposed and 50% unexposed). At endline, in Intervention arm 1, screening was carried out based on both television station exposure and attendance of at least one *GRS arisan*, a core element of the campaign (25% of the sample were exposed to *GRS arisans* and the TV station; 25% were exposed to the *GRS arisans* only; 25% were exposed to the TV station only; and 25% were exposed to neither of the components). At endline, intervention arm 2 was screened as per the baseline study. Figure 2 shows the flow diagram for the trial. No screening was carried out during recruitment in the control arm.

### *Outcome Assessment*

The main outcomes of the study were the effect of the interventions on: 1) dietary diversity score, 2) the proportion of mothers feeding the child an unhealthy snack in the last 24h. Secondary outcomes included: 1) the proportion of mothers who exclusively breastfeed (EBF), 2) the frequency of fruit intake, 3) the frequency of vegetable intake, and 4) the frequency of unhealthy snack intake. EBF was measured as a secondary outcome because the study was not powered to detect a change in this indicator and the 3 month pilot was thought to be too short a period in which to observe noticeable change. The dietary diversity scores and the proportion of mothers who exclusively breastfed were measured using standardised tools recommended by the WHO.<sup>30</sup> A 24 hour food recall tool was administered by trained nutritionists using a multiple pass approach.<sup>31</sup> Dietary diversity was then determined by categorising food into seven groups according to the WHO Guidelines on Indicators for Assessing Infant and Young Child

Feeding.<sup>30</sup> Snacking was assessed by identifying any unhealthy snack foods that the child had consumed in the last 24 hours. What constituted an 'unhealthy' snack was determined through a marketplace assessment by nutritional experts. Unhealthy snack categories including biscuits, fried snacks, cakes and sweets. The frequency of consuming vegetables, fruit and unhealthy snacks was assessed using 13 core food categories and a seven-point scale with a range from several times a day, to never consumed.<sup>32</sup> Weight-for-age was used as a proxy for the nutritional comparability of children in the different study arms,. A total of 469 participants were surveyed (163 in intervention arm 1, 154 in intervention arm 2 and 152 in the control arm) during baseline data collection in April 2014, one month before the pilot intervention commenced. 564 separate participants were sampled at endline (243 in intervention arm 1, 171 in intervention arm 2 and 150 in the control arm) in September 2014, one month after the pilot intervention. Outcomes were measured by trained enumerators who had no connection with the intervention and were given information sufficient only to be able to measure exposure accurately.

To explore the validity of nutritional reporting and provide a richer understanding of the target behaviours in context, we carried out video observations with a sub-sample of ten households from intervention arm 1 and ten households from intervention arm 2, prior to the outcome assessment. Each observation was conducted during one of two time slots – either between 6 to 9 am and/or 11 am to 1 pm. This generally allowed for at least one meal or feeding period to be observed.

#### *Ethics and Consent:*

Ethical approval for this study was granted by the London School of Hygiene and Tropical Medicine and the Human Ethics Committee of the Faculty of Medicine at the University of Indonesia. Written informed consent was obtained from caregivers in all participating households.

#### *Sample Size*

The sample size was calculated based on the assumption of a 20% difference between intervention and control villages in dietary diversity at end-line. Estimates were based on predicted changes in dietary diversity because it was assumed that changes in breastfeeding behaviour would not be observable over a three month period and because snacking had not been previously measured in nutritional studies. The study was powered at 80% with an alpha 0.05. The crude sample size, ignoring the effect of clustering, required 103 households per study arm. An ICC of 0.04 was assumed with a cluster size of 15 households per cluster. This resulted in a design effect of 1.5 and hence a sample size of at least 150 households per arm.

#### *Data analysis*

Data was entered and checked in an SPSS database simultaneously with data collection so any errors could be followed up the next day. The analysis was done in STATA 12. Binary outcomes (exclusive breastfeeding, unhealthy snacking within the last 24h) were analysed using binomial regression analysis, calculating the differences in proportions across study arms (link function: identity; distribution: binomial). Clustering at village level was accounted for by the use of Generalised Estimating Equations. Continuous outcomes (food diversity score, fruit and vegetables frequency score) were analysed using linear regression with random effects (to adjust for village level clustering). Questions relating to frequency of fruit intake, vegetable intake and meat intake were combined (e.g. 'orange and yellow fruits and vegetables' and 'other fruits') in a single score derived from principle component analysis (PCA). All analyses were adjusted for the baseline values of the respective outcomes, averaged at village level.



Two separate models were made for each outcome: the first compared intervention arm 1 and intervention arm 2 against the control arm; the second compared intervention arm 1 directly with intervention arm 2. Because exposure to the community activations (specifically *GRS arisan* meetings) was predicted to be low, it was decided to screen for exposed households in intervention arm 1. Therefore we were not able to conduct a true intention to treat analysis. For the analysis we compared the different outcome measures between intervention arm 1 and 2, adjusted for baseline values of the outcomes. We first conducted an exploratory analysis ('combined analysis') including all participants, regardless of whether they were exposed to the TV station or the community *GRS arisan* meetings. Then we conducted three different per-protocol analyses on the different subgroups of study participants actually exposed to the intervention. The first per-protocol analysis was restricted to participants who, based on screening, were found to actually regularly view the TV station on which the campaign adverts were screened. The second per-protocol analysis was restricted to participants who, based on screening, reported they had attended at least one *GRS arisan*. The third per-protocol analysis was restricted to those who, based on screening, reported to regularly watch the television station and reported they had attended at least one *GRS arisan*.

Information obtained from the video footage was analysed using a parsing matrix, whereby feeding practices were broken down into different key behavioural actions. Additionally, analysts recorded outcomes relating to complementary feeding, snack food and breastfeeding.

## Results

### *Social, demographic and nutritional characteristics*

At baseline and endline the two intervention arms were found to be demographically similar but both differed from the control arm in the separate province on several indicators including education and employment status of the mother, household income and mean age of the child (see table 2). Despite these between-arm differences, each of the study arms remained similar from baseline to endline on most demographic indicators. The majority of the participants were found to be of C or D socio-economic status. The prevalence of children classified as 'underweight' was 14.7% and this figure was similar across all study arms.

### *Exposure to the intervention*

#### Community activations

Among the 51% (n=125) of the sample who reported they had attended at least one GRS *arisan* meeting (attained through screening), a disaggregation of attendance showed that only 30% (n=38) of those who ever attended, graduated from the program (defined as having attended five or more meetings). Table 3 gives a breakdown of exposure to the elements of the community activations.

#### Television adverts

Participants were shown a picture of *Ibu Rumpi* and asked if they had seen a television advert featuring her. 32% of participants in intervention arm 1 (TV + community activations) said that they had seen such an advert, compared to 14% in intervention arm 2 (TV only). Of those in intervention arm 1, who reported that they watched the TV station and attended GRS *arisan* meeting, 66% had seen one of the campaign adverts and 7% could recall at least 2 of the adverts (see table 4).

### *Outcomes: Dietary Diversity*

Dietary diversity scores (DDS) were calculated for each child aged 6-24 months, based on mother's report of what the child ate yesterday. The DDS increased in both intervention arms while dropping slightly in the control arm (see Figure 3 and table 5). Adjusted for baseline values, intervention arm 1 had a one point higher DDS than the control arm (95%CI: 0.4 - 1.2) and intervention arm 2 was 0.8 points higher (95%CI: 0.6 - 1.4). Direct comparison between the two intervention arms suggests that there were small increases in dietary diversity among those in the TV + community activation arm compared with those in the TV only arm. However, the confidence intervals were wide on the per protocol analysis (95%CI: -0.2 - 0.8)

There was an 0.59 point increase in the reported frequency of vegetable intake in intervention arm 1 (95%CI: 0.10 – 1.07) and a lesser increase in Intervention arm 2 (0.37, 95%CI: -0.11-0.85), based on the PCA analysis of 'green leafy vegetables', 'tubers', 'white root vegetables' and 'other vegetables'. The first component explained 58% of the variation among the variables (KMO 76%). There was no observed change in reported meat intake.

### *Snacking*

The effect of the intervention on unhealthy snack consumption was measured through dietary recall. The interventions did not reduce unhealthy snacking practices (see figure 3 and table 5). A comparison of intervention 1 with intervention arm 2 suggests the additional effect of the GRS *arisans* may have resulted in mild reductions in unhealthy snacking, but the confidence intervals include zero (95%CI: -19 - 15).

The intervention also promoted fruit as a healthy alternative snack. The first component explained 79% of the variation among the variables (KMO 50%). This showed a statistically significant increase in fruit frequency in intervention arm 1 (95%CI: 0.40-1.16) compared to intervention arm 2 (95%CI: 0.04-0.73) at endline.

#### *Outcomes: Breastfeeding*

A month by month analysis of exclusive breastfeeding at endline explored whether the interventions had an effect on extending EBF, (see Figure 4). During the first three months of life significantly higher rates of exclusive breastfeeding were observed in intervention arm 1 compared to intervention arm 2. In month 1 there was a proportional increase of 22% in intervention arm 1 (95% CI: 17.9% – 26%, *P-value: 0.01*), in the second month there was an increase of 18% (95% CI: 14.4% – 22%, *P-value: 0.04*) and by the third month there was still at 16% difference (95% CI: 12.3% – 19.5%, *P-value:0.05*). Rates were higher compared to the control arm also, but statistical support was low (see Table 4).

## Discussion

### *Effect of the intervention on the three targeted behaviours*

The evaluation suggests that the intervention had some effect on improving dietary diversity and the regularity of vegetable intake among children 6-24 months. Both of the intervention arms saw an increase in dietary diversity with little added effect of community activations above that of the TV exposure. Despite these improvements, the average dietary diversity score at endline was still less than the recommended four or more food groups per day. Consistent with the increase in dietary diversity, vegetable intake was found to increase in both arms, but was higher in the arm exposed to *GRS arisans*. The intervention did not focus on increasing the intake of animal proteins, and hence it was not surprising that no change in frequency was observed.

The intervention had no noticeable impact on unhealthy snacking behaviour though it did appear to have improved the intake of healthier snacks such as fruits-which were portrayed as appetising and the 'right' thing to feed a child. Both television adverts and *GRS arisan* attendance may have been influential in this behavioural shift occurring. The absence of a decrease in unhealthy snacking may have been because the campaign adverts only portrayed one type of snack – crisps. As such mothers may have remained unaware that other snacks such as biscuits or sweets should also be reduced. Alternatively, this pattern, whereby unhealthy snacking habits continue alongside the new healthy snacking behaviour, is consistent with other studies which suggest that new, desired behaviours may be treated as supplementary to existing behavioural practices.<sup>33</sup>

Despite the small sample population, trends from the by-month aggregation of breastfeeding practice indicate that the intervention may have had a positive influence on breastfeeding practice but this potential effect was not able to be captured within the short 3 month period between baseline and endline surveys. Changes in these first 3 months of life are more likely to reflect the influence of the intervention as mothers who had given their infants something other than breast milk prior to the study would be unable to 'turn back time' and restart exclusive breastfeeding. Among the study populations mixed feeding began early, suggesting that the first month of life is the critical period in which to intervene as this is when almost half of mothers stop exclusive breastfeeding.

### *Video observation*

This study used video observation of food intake to explore the relationship between observed and reported behaviour and add insight to the findings. Although observation was only conducted among a small sub-sample of participants, the findings generally supported the quantitative findings and added some new insights. Mothers were found to breastfeed for short periods of time only, normally less than 8 minutes. It is recommended that for nutritional adequacy and balance, a breastfeed should typically last for a minimum of 10 minutes.<sup>34</sup> This confirmed our earlier findings that breast feeding was not employed by mothers solely for its nutritional contribution, but rather as a way to calm a restless child or make it sleep. Video footage also showed that complementary food lacked diversity, with most mothers being observed to give their child rice and just one other main ingredient each mealtime. Observations were found to be similar to the dietary recall data from the previous day, indicating limited between-day variability in feeding patterns.

The video observations provided some evidence of increased fruit intake. During the baseline observation, biscuits were by far the most common snack given to children, with healthy snacks such as fruit being relatively rare. However, by the endline observation, fruit was the most common snack in both study arms

(consistent with the emphasis in the TV ad, which showed fruit as a healthy snack). Snacks, in addition to calming a child when they cried, were observed to be a substitute food for main meals when a child refused to eat what the mother had initially prepared. This led to a vicious cycle of feeding whereby snacks, given shortly before a meal, would reduce what was consumed at mealtime, leaving the child requesting another snack shortly after mealtime. We suggest that video observation is cheap, feasible and acceptable in this setting and should be more widely used in dietary research.

#### *Study limitations*

The study had a relatively short baseline to endline time period, limiting the likelihood of observing change against complex long-term behaviours such as exclusive breastfeeding in the first 6 months of life. This also meant it was not possible to adjust for seasonal trends. The timing of the intervention also coincided with the presidential election and the fasting month of Ramadan, both of which diverted the attention of project staff and target audiences.

Socio-demographic differences were observed between the intervention arms in Sidoarjo district of East Java, and the control sites in Kudus in Central Java, suggesting that these sites were less comparable than we had assumed. The challenges of using randomised control trials to measure the effect of mass media campaigns on behaviour change are recognised.<sup>35,36</sup> Future studies might employ alternative designs for measuring the effect of mass communication, for example by using interrupted time-series data as the counterfactual.

The desired coverage of the community activations and dosage of exposure was sub-optimal (particularly GRS *arisan* meetings). This led to the decision to purposively enrol study participants based on exposure status. Therefore an intention-to-treat analysis regarding the effect of the GRS *arisan* meetings was not possible. The implications are that the true effect of the intervention, delivered at less than optimal coverage, may not have been captured. Additionally, this may mean that the two intervention arms were not strictly comparable with respect to the potential participation at GRS *arisan* meetings, which may have introduced bias. For the TV exposure, screening was done in the same way in the two intervention arms at baseline and endline so bias in TV exposure is unlikely. Capturing the true effect of behaviour change interventions in programme contexts remains challenging given that implementation may not always be optimal and dose of exposure may be low.

This study made an active effort to not rely solely on self-reported data, however the principle outcome measures were still derived from these methods. It is reassuring that in this instance the video observation data generally supported the primary measures. However, it is important to acknowledge the growing body of literature which documents the poor validity and reliability of self-reported nutritional assessment.<sup>37-42</sup> Indonesia is also understood to be a context where social desirability bias is high.<sup>43</sup>

#### *Application of BCD Theory to nutrition*

This is the first time that the BCD framework has been applied to non-hygiene related behaviours. It was found to be equally applicable to nutrition, with the ABCDE process generating new insights and new approaches to nutrition promotion. Gossip proved a useful behavioural lever, with beneficiaries identifying with the character of *Ibu Rumpi*. Consistent with our hypothesis, the findings of this study suggest that mass-media campaigns which utilise strong motives rather than health knowledge can be effective in changing behaviour. Complementing TV adverts with community activations is likely to be more effective, but the true value of doing so must be weighed against the logistical challenges of delivering high-fidelity community activations at scale and their cost-effectiveness. Exposure to both campaign components was

sub-optimal in the pilot and increasing exposure and dose is likely to yield more significant behaviour change. This intervention, based on strong emotional drivers of behaviour change rather than on imparting 'nutritional knowledge', was designed to be replicable at large scale. The results of this pilot have led to the expanded roll-out of a modified version of the program. This uses a national TV station to screen the adverts and delivers the emo-demo activities through existing government health programs rather than specialised *arisans*. A larger trial will evaluate the long-term health outcomes of the intervention.

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Table 1: Intervention Description

Intervention activity	Regularity	Purpose	Detailed content
Television adverts	Screened daily for 3 months	These established the character of IbuRumpi and provided a unifying concept for the whole campaign. TV adverts tend to have high fidelity which complemented the community activations which were highly reliant on the quality of facilitators.	Three adverts were developed, one for each targeted behaviour. Each included Ibu Rumpi as the primary character and in each case she was found gossiping about the feeding behaviour of others only to be told that she was in the wrong. Each advert intentionally incorporated several key concepts: 1) shock was achieved by an action of hitting the wrong behaviour away (ie flicking a bottle into the bin, or hitting someone's hand away so they couldn't provide a bad snack), 2) The key message of 'Got it wrong, get it right' 3) an expression of embarrassment by Ibu Rumpi where she slaps her had to hear head and says 'ooalla!' 4) Naturalism – the adverts were set in a common streetscape in Sidoarjo which was done so that the audience felt they could relate to the characters.
Teaser posters	2 different posters, distributed with a 2 week gap, in advance of campaign.	The first poster was designed to spark curiosity and get people talking even though no information was given. The second 'answered' those questions and encouraged mothers to join the movement by becoming part of their local <i>arisan</i> group.	The first teaser poster featured only Ibu Rumpi and the words 'Got it wrong?' The poster was unbranded by had a link to the social media site for the campaign. The second poster also featured Ibu Rumpi and was designed to go up alongside the first. The text on this poster invited mothers to join the <i>arisan</i> groups and become top mothers.
Formation of women's groups (GRS <i>Arisans</i> )	10-15 women in each, multiple in one community At least 5 meeting per woman	<i>Arisan</i> groups are a familiar social structure throughout Indonesia and act as informal loan system among neighbours, accompanied by much socialising during meetings. Due to the need for regular monetary contributions there is a high level of social pressure to always attend. The intervention established several of these groups for mothers in each community. <i>Arisans</i> were designed to be the delivery channel for the 'emo-demo' activities. It was hoped that the <i>arisan</i> group structure would lead to the development of a support network among mothers, and a possible small pot of money to continue activities.	In addition to the posters facilitators worked with women's leaders and health post staff to identify eligible mothers and invite them to join. Eligible mothers were women with children under 2 or pregnant mothers. One <i>arisan</i> was set up per sub-village region. Meeting were held at convenient community locations including health posts, village halls, day care centres and even individual households. Meeting were held at times that were identified as convenient for mothers, normally this was one the weekend. During each meeting there were 2 or 3 emo-demos and time allocated for sharing and discussion among the group, including tracking each other's progress against the target behaviours. The sessions were led by one of the trained facilitators and over the course of the 6 meetings local women's leaders were trained to be able to replicate the activities.
Membership materials	Distributed on joining	Designed to make mothers feel that they were part of a social movement and thereby create a sense of social pressure to adhere to the behaviours.	When mothers joined the <i>arisans</i> they received membership cards which included pledges about the target behaviours and also about spreading 'healthy gossip' to other mothers in their community. Each time they came to an <i>arisan</i> meeting they would discuss their progress and receive a stamp from the facilitator if they had actively maintained the pledge. Mothers also received <i>arisan</i> member badges which they were encouraged to wear to show that they were affiliated with the movement. Lastly membership stickers were placed outside each member's house. These were personalisable allowing each member to write their name on the sticker. Each read 'I'm part of the Healthy Gossip Movement – Ask me how to be a top-notch mother' and had a photo of Ibu Rumpi giving a thumbs-up.
Emo-Demos (emotional demonstration activities)	2-3 per <i>arisan</i> session, 20 in total	Each activity tapped into behavioural motives such as disgust, nurture, creativity and curiosity and used surprise to alter the way mothers think about child feeding.	These included the following activities (their prime motive or behavioural lever is indicated in brackets): Baby Tummy (disgust), Refilling the glass (curiosity), Creating bonds (nurture), Aerobics

Intervention activity	Regularity	Purpose	Detailed content
			(attract), Throwing the bottle (disgust), Time competition (convenience and time saving), Cost calculations (economic savings), Preparing to go out (convenience), Ideal Plate (shame and curiosity), Food continuum (curiosity), Fashionable food (fashion and affiliation), Food art (creativity), Recipe development (creativity and pride), Feeding timeline (shame and curiosity), Disgusting snacks (disgust), Prawn cracker tag (shame and curiosity), Instant satisfaction (knowledge), Shopping basket (economic savings), "What are you doing?" (shame and curiosity), Roll the dice (shame). A full description and of each emo-demo is available here: <a href="http://blogs.lshtm.ac.uk/envhealthgroup/files/2015/04/Emo-Demo-Descriptions.pdf">http://blogs.lshtm.ac.uk/envhealthgroup/files/2015/04/Emo-Demo-Descriptions.pdf</a>
House to house visits and tablet use	All women at least once, ideally 2-3 times	These were designed to reach mothers in the setting where the behaviours take place, to influence this setting by getting them to put up trigger stickers and to encourage mothers to join the <i>arisans</i> if they had not done so. Tablets were chosen as a mode of deliver because they, as well as the material itself, would be unusual and therefore create surprise in the target. They were also considered to be a suitable medium through which to then engage mothers in two-way communication about the issues.	Facilitators wore campaign t-shirts while conducting house-to house visits so that they were clearly identifiable and were accompanied by female leaders in the community to ensure acceptability. During house to house visits the following activities were intended to take place: <ul style="list-style-type: none"> <li>○ Screening of adverts on the tablets and discussion of the three core behaviours.</li> <li>○ Informing the mother about the <i>arisan</i> meetings and inviting her to join.</li> <li>○ Ask the mother's permission to put up the trigger stickers, one which said "bottle feeding clogs breast milk" on the water dispenser and another that said "Don't be dull and feed rice only" on the rice cooker.</li> <li>○ Invite her to 'like' the GRS social media pages.</li> <li>○ Ask if she has a nutritionally diverse recipe that she would like to share via the tablet cookbook.</li> <li>○ Use the calculator on the tablet to calculate how much she could save by not giving her child formula milk.</li> <li>○ Take a photo of the mother and her baby if the mother is willing to pledge to adopt a target behaviour. This can be shared via social media or on the community noticeboard.</li> </ul>
Integration into Quran recital meetings	As they occur	Religious leaders are influential individuals in the community and the Quran makes references to the importance of breastfeeding and complementary feeding, reminding parents of this enabled the greater moralisation of these behaviours and reminded the community that it is a part of their tradition.	Passages from the Quran were identified that that made specific references to breastfeeding and the importance of food variety. Facilitators worked with recital leaders to enable them to join Quran recital meetings, explain about the campaign and then encouraged the religious leader to discuss these passages among the group.
Posters on vegetable cart vendors	One off interaction	Collaboration with street vendors enabled us to remind mothers about healthy complementary foods at the time when they were purchasing foods for their families.	These posters were produced as giant stickers so that they could easily adhere to vegetable vendor carts. There were two types of posters, one targeting snacking and one targeting complementary feeding. On one side of each poster there was a photo of the wrong behaviour (ie unhealthy snack or a dish of mainly rice) that was crossed out and had a photo of Ibu Rumpi looking embarrassed. On the other side was the correct behaviour with Ibu Rumpi giving a thumbs-up.
Social media use	Updated daily	This capitalised on the fact that social media use in Indonesia is seen as being very popular even if it is not yet common	Facebook groups were set up for each community. Facilitators were the moderators of these and mothers who joined the <i>arisans</i> were encouraged to join the social media

Intervention activity	Regularity	Purpose	Detailed content
		among C and D socio-economic groups. Tablets enabled mothers to engage with social media even if their own device lacked this capacity. Social media was intended to make mothers feel part of a bigger movement and provide a forum to share success stories and document what was going on during the campaign.	group also. Facilitators aided women to do this via the tablets if they did not have regular internet access through their mobile phones. Facilitators worked with <i>arisan</i> members to share photos and success stories of the GRS campaign. A central, open facebook page was also created where a central moderator brought together a selection of these photos and stories and responded to questions from anyone who liked the page.
Community noticeboards	2 noticeboards per community. Updated every month at least.	Community noticeboards served as an alternative to social media but also featured success stories, schedules for what was happening at <i>arisans</i> and photos from campaign events. They had the added benefit of being seen by the whole community so there was a sense of pride associated with being recognised as a good mother.	Facilitators worked with community leaders to locate the noticeboards in central locations. Noticeboards were updated with photos from GRS campaign activities and success stories. Noticeboards featured the stories of top mums, shared top feeding tips and provided a schedule of upcoming activities.
Graduation and associated materials	Once at end of campaign	This was designed to both publically recognise mothers who had shown their commitment to adopting the three behaviours but also to get them to publically commit to be ambassadors for encouraging these behaviours among others in the community.	Graduation events were led by village leaders and attended by the family of <i>arisan</i> members. Village leaders presented graduation certificates and a graduation badge to mothers who had attended more than 5 <i>arisan</i> meetings and participation certificates to others who had not reached this target. Graduating mothers were asked to make a pledge to personally maintain the target behaviours and to encourage other mothers in their community to do the same.

Figure 1: Images depicting the formative research process and intervention components



Figure 2: Flow Diagram of Trial

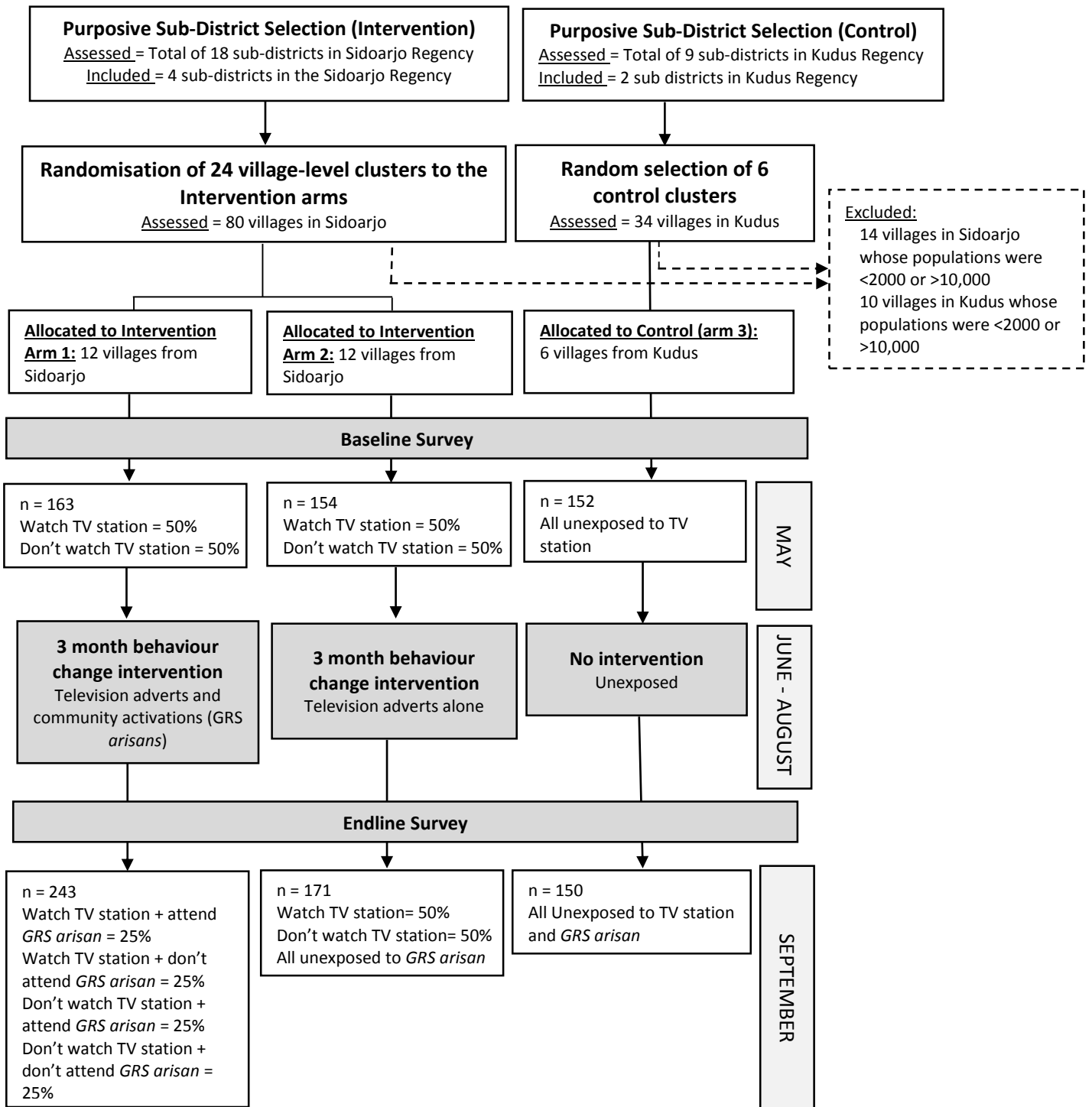


Table 2: Comparison of participant characteristics between baseline and endline and across all study arms

Socio-demographic Characteristics	Intervention arms (1+2)		Control arm (3)		P-value comparing study arms at endline*
	Baseline (n=317)	Endline (n=414)	Baseline (n=152)	Endline (n=150)	
<b>Marital status of Mother (%)</b>					0.737
Married	98	99	100	99	
<b>Education of Mother (%)</b>					<0.001
No Schooling	0	3	1	3	
Middle school or below	29	39	62	59	
High School	54	49	26	34	
University	16	8	7	4	
<b>Working status of mother (%)</b>					<0.001
Not employed	65	64	70	65	
Full time job	21	24	7	10	
Part time job	13	12	22	25	
<b>Sex of children under 2 years (%)</b>					0.526
Male	51	54	52	51	
Female	49	46	48	49	
<b>Household monthly income - (IDR)</b>					
Median	2,000,000	2,200,000	1,000,000	1,500,000	<0.001
<b>Percentage of household monthly income spent on food</b>					
Median (%)	53	40	60	55	<0.001
<b>Weight-for-age Z score (WAZ)</b>					
< -2SD (%)	12	12	16	13	0.912
< -3SD (%)	1	2	1	2	0.899
Mean Estimate	-0.7	-0.7	-0.8	-0.8	0.518
<b>Age in Months</b>					
Mean (±SD)	11.7(±10.8)	11.1 (±6.7)	10.37 (±10.3)	9.9 (±5.3)	0.04

\*Comparison between the intervention arms (1 and 2 combined) and the control arm.

Table 3: Exposure to community activation components

<b>Exposure to Community Activation Components</b>	<b>Intervention arm 1</b>
<b>Number of GRS <i>arisans</i> attended</b>	N=243, % of respondents in Intervention arm 1
Those who reported they did not attend a meeting	118 (48%)
Those who reported they attended 1 meeting	27 (11%)
Those who reported they attended 2 meetings	27 (11%)
Those who reported they attended 3 meetings	19 (8%)
Those who reported they attended 4 meetings	11 (5%)
Those who reported they attended 5 meetings	12 (5%)
Those who reported they attended 6 meetings	24 (10%)
Other (Reported attendance at >6 meetings)	2 (1%)
<b>Received campaign materials</b>	N=125, % of respondents in Intervention arm 1 who reported attending at least 1 GRS arisan meeting
GRS Membership cards	67 (53%)
GRS badges	81 (65%)
Ringtones	1 (1%)
Membership stickers	61 (49%)
Trigger stickers	82 (66%)
<b>House-to-house visits</b>	N=243, % of respondents in Intervention arm 1
GRS facilitator visited house	61 (25%)
Visited once	40 (66%)
Visited twice	16 (26%)
Visited three times	4 (7%)
Visited four times	1 (2%)



Table 4: Exposure to Television Adverts

Exposure to Television Adverts	Intervention arm 1 (n=243)	Intervention arm 2 (n=171)
<b>Reported seeing an advert with Ibu Rumpi in it</b>	77 (32%)	24 (14%)
Among those who were exposed to TV and GRS <i>arisans</i>	41 (66%)	N/A
Among those who were exposed to the TV but not GRS <i>arisans</i>	18 (30%)	19 (21%)
Among those who were not exposed to the TV but were exposed to GRS <i>arisans</i>	15 (25%)	N/A
Among those who were not exposed to TV or GRS <i>arisans</i>	3 (5%)	5 (6%)
Reported the message was about child feeding	24 (10%)	12 (7%)
Reported the message was about Breastfeeding	21 (9%)	5 (3%)
Reported the message was about snacking	14 (6%)	2 (1%)
Had seen two or more adverts and were able to recall the behaviours	18 (7%)	5 (3%)

Figure 3: Baseline to endline comparisons against primary outcomes – (1) Dietary Diversity Scores among children 6-24 months; and (2) Proportion of children 6-24 months, who received an unhealthy snack in the last 24 hours according to dietary recall.

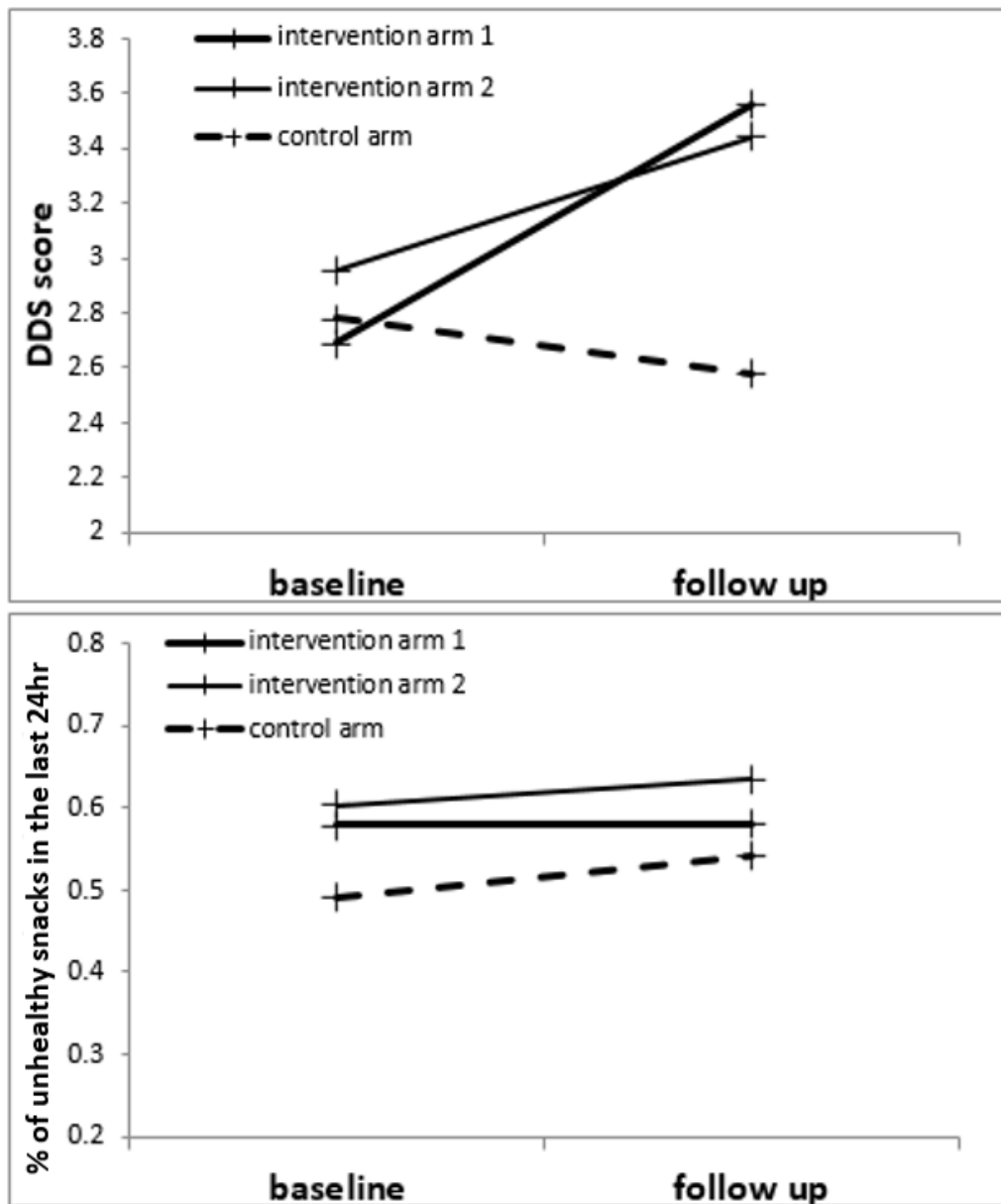


Figure 4: Proportion of children exclusively breastfed, by month, at endline.

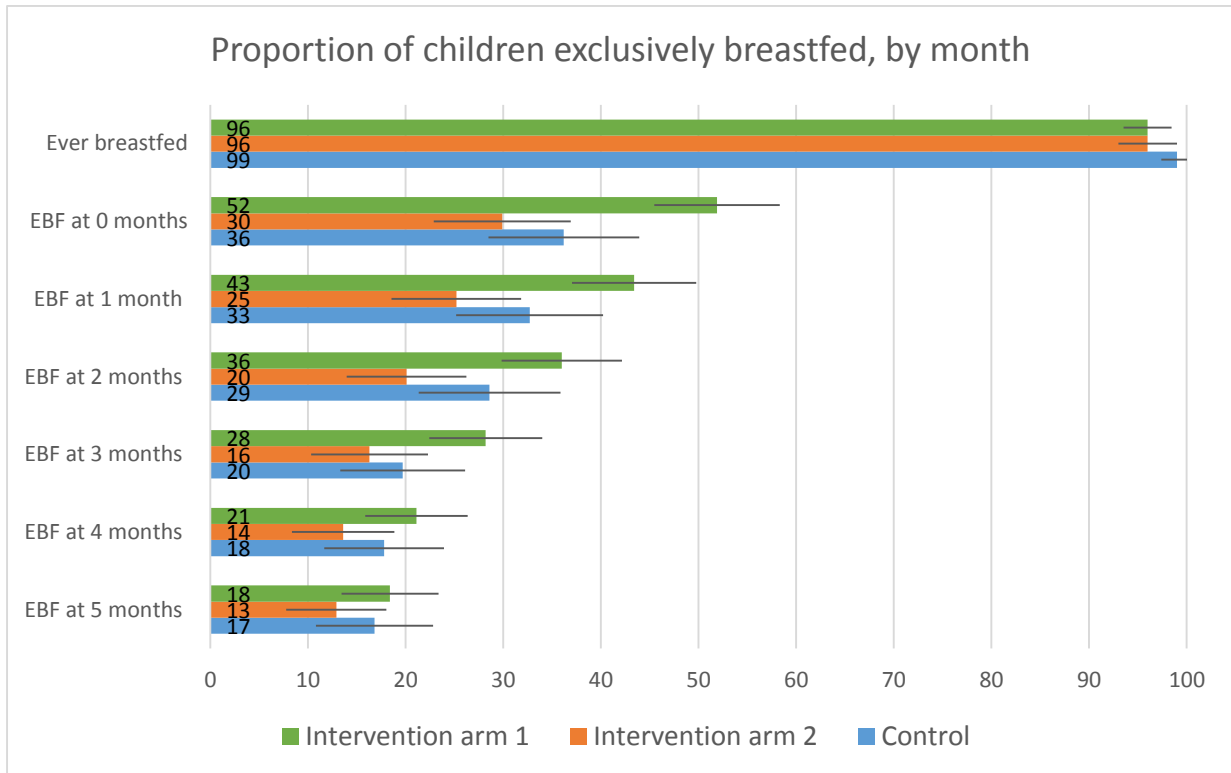


Table 5: The combined and per-protocol analyses of the proportional differences in the primary outcomes of breastfeeding, dietary diversity and snacking

	Dietary Diversity				Unhealthy Snacking			
	Total N	Mean DDS, SD (village level)	Difference*	95% CI	Total N	% snack in last 24h	% Difference *	95% CI
<b>Combined analysis</b>								
<b>Control Arm</b>	126	2.6 (0.4)	(reference group)	-	126	54	(reference group)	-
<b>Intervention arm 2 (TV ads)</b>	134	3.4 (0.6)	+0.8	0.4/1.2	134	63	+9	-6/24
<b>Intervention arm 1 (TV ads + Arisan)</b>	193	3.6 (0.4)	+1.0	0.6/1.4	193	58	+4	-10/18
<b>Intervention arm 1 vs. Intervention arm 2 (Effect of Arisan)</b>	-	-	+0.2	-0.2/0.6	-	-	-5	-17/5
<b>Per protocol - exposed to the TV station on which the adverts were screened</b>								
<b>Control Arm</b>	126	2.6 (0.4)	(reference group)	-	126	54	(reference group)	-
<b>Intervention Arm 2 (TV ads)</b>	71	3.5 (0.6)	+0.9	0.4/1.4	71	71	+17	3/32
<b>Intervention arm 1 (TV ads + Arisan)</b>	96	3.8 (0.4)	+1.2	0.7/1.6	96	61	+7	-11/24
<b>Intervention arm 1 vs. Intervention arm 2 (Effect of Arisan)</b>	-	-	+0.3	-0.3/0.8	-	-	-11	-26/4
<b>Per protocol - Attended at least 1 GRS Arisan</b>								
<b>Control Arm</b>	126	2.6 (0.4)	(reference group)		126	54	(reference group)	-
<b>Intervention Arm 2 (TV ads)</b>	134	3.4 (0.6)	+0.8	0.4/1.3	134	63	+9	-6/24
<b>Intervention arm 1 (TV ads + Arisan)</b>	106	3.7 (0.4)	+1.1	0.6/1.6	106	63	+9	-6/24
<b>Intervention arm 1 vs. Intervention arm 2 (Effect of Arisan)</b>	-	-	+0.3	-0.2/0.8	-	-	0	-13/13
<b>Per protocol - Exposed to the TV station and attended at least on GRS Arisan</b>								
<b>Control Arm</b>	126	2.6 (0.4)	(reference group)		126	54	(reference group)	
<b>Intervention Arm 2 (TV ads)</b>	71	3.5 (0.6)	+0.9	0.4/1.4	71	54	+18	4/32
<b>Intervention arm 1 (TV ads + Arisan)</b>	54	3.9 (0.4)	+1.3	0.7/1.8	54	59	+16	-1/34
<b>Intervention arm 1</b>	-	-	+0.3	-0.2/0.9	-	-	-2	-19/15

<b>vs. Intervention arm</b> <b>2</b> (Effect of Arisan)								
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\*Random effects linear regression, adjusted for baseline values and clustering at village level.

\*\*Binomial regression (binomial distribution, identity link), adjusted for baseline values and clustering at village level using GEE and robust SE.