

## BRIEF REPORT

# Mortality and Malnutrition Among Populations Living in South Darfur, Sudan

## Results of 3 Surveys, September 2004

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IN EARLY 2003, 2 REBEL MOVEMENTS (the Sudanese Liberation Army and the Justice and Equality Movement) launched an insurgency against the rule of Khartoum and the government of Sudan, and *Janjaweed* tribal militias have responded with decisive counteroffensives. Militia attacks have been blamed by refugees and internally displaced persons (IDPs) for indiscriminate killings, rape, abduction, cattle and property looting, and razing of villages. More than 1.5 million people (25% of the population of the region) are now scattered in 127 encampments in Darfur and 15 in neighboring Chad.

Humanitarian assistance arrived late, having been limited initially by severe government restrictions and low institutional donor interest; and also by insecurity, which is ongoing. Médecins Sans Frontières (MSF) began work in West Darfur in December 2003, and operations in South Darfur, including feeding centers and primary care clinics, opened in May 2004 and have been centered on 3 sites (FIGURE 1). Kass is a busy market town where 50 000 IDPs arrived mainly in November 2003 and now live both within the compounds of the 30 000 residents and in distinct

**Context** Mass violence against civilians in the west of Sudan has resulted in the displacement of more than 1.5 million people (25% of the population of the Darfur region). Most of these people are camped in 142 settlements. There has been increasing international concern about the health status of the displaced population.

**Objective** To perform rapid epidemiological assessments of mortality and nutritional status at 3 sites in South Darfur for relief efforts.

**Design, Setting, and Participants** In August and September 2004, mortality surveys were conducted among 137 000 internally displaced persons (IDPs) in 3 sites in South Darfur (Kass [n = 900 households], Kalma [n = 893 households], and Muhajiria [n = 900 households]). A nutritional survey was performed concomitantly among children aged 6 to 59 months using weight for height as an index of acute malnutrition (Kass [n = 894], Kalma [n = 888], and Muhajiria [n = 896]). A questionnaire detailing access to food and basic services was administered to a subset of households (n = 210 in each site).

**Main Outcome Measures** Crude and under 5-year mortality rates and nutritional status of IDPs in Kass, Kalma, and Muhajiria, South Darfur.

**Results** Crude mortality rates, expressed as deaths per 10 000 per day, were 3.2 (95% confidence interval [CI], 2.2-4.1) in Kass, 2.0 (95% CI, 1.3-2.7) in Kalma, and 2.3 (95% CI, 1.2-3.4) in Muhajiria. Under 5-year mortality rates were 5.9 (95% CI, 3.8-8.0) in Kass, 3.5 (95% CI, 1.5-5.7) in Kalma, and 1.0 (95% CI, 0.03-1.9) in Muhajiria. During the period of displacement covered by our survey in Muhajiria, violence was reported to be responsible for 72% of deaths, mainly among young men. Diarrheal disease was reported to cause between 25% and 47% of deaths in camp residents and mainly affected the youngest and oldest age groups. Acute malnutrition was common, affecting 14.1% of the target population in Kass, 23.6% in Kalma, and 10.7% in Muhajiria.

**Conclusion** This study provides epidemiological evidence of the high rates of mortality and malnutrition among the displaced population in South Darfur and reinforces the need to mount appropriate and timely humanitarian responses.

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encampments in school grounds and waste areas. Kalma, which in January 2004 was a small village on the main railway line running east of the regional capital Nyala, is the largest single IDP settlement in South Darfur and in August 2004 had 66 000 inhabitants; it

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has continued to grow. Muhajiria is in relatively inaccessible rebel-held territory east of Nyala and has had 2 major influxes of new arrivals, one in October 2003 and another in August 2004. The 3 surveys reported herein were part of site-specific assessments of health and nutritional status designed to inform the delivery of relief activities in the region.

## METHODS

We performed 2-stage household-based cluster surveys in 3 sites in South Darfur (FIGURE 2). In 2 of these (Kass and Muhajiria), residents were considered by aid agencies to be as vulnerable as IDPs; therefore, both groups were surveyed. Sectors were defined by the Sudanese authorities for local resident populations; for IDP camps, the sector boundaries used were those recognized by IDPs (populations) and their community leaders and were mainly distinct geographical landmarks. Sector-specific populations were estimated at each site using a combination of local government census (for residents), the reports of community leaders (for IDPs), health worker censuses, World Food Program data, and shelter counts.

Households, defined as groups of people eating together, were selected on the basis of the standard World Health Organization/Expanded Program of Immunization method.<sup>1</sup> For the first stage of sample selection, we allocated numbers of clusters to camp or town sectors proportionally to the population.<sup>2</sup> For the second stage, the first dwelling within each cluster was selected either by walking in a random direction from the center to the perimeter, counting the number of households ( $n$ ) and randomly selecting a number between 1 and  $n$ , or, where dwellings were arranged on a grid, by randomly selecting a global positioning system coordinate. Subsequent households were selected by proximity.

At each site, general household status, crude and under 5-year mortality, and nutritional and vaccination status of children aged 6 to 59 months were assessed simultaneously within the same

survey design. Within any 1 cluster, the general household questionnaire was administered to the first 7 households and the mortality questionnaire to the first 30 households. Anthropometric data were collected on all children residing within selected households and aged 6 to 59 months until data had been obtained on a total of 30 children. Sample size calculations were performed prior to the survey. Nine hundred households (30 clusters  $\times$  30) or 4500 people (assuming a mean household size of 5 people) would have been sufficient to estimate a crude mortality rate of 2.0 per 10 000 per day with a 95% confidence interval (CI) of 1.0 to 3.0, a recall period of 30 days, and a design effect (loss of variance due to intracluster homogeneity) of 2. Similarly, with an expected prevalence of malnutrition of 10%, 900 children would give a 95% CI of 7.5% to 13.3%. For access to items and services, 210 households give adequate precision, assuming a prevalence of 50% for the main outcomes.

Each survey team included a community health worker, a local person who spoke Arabic and English, and a member of the expatriate or Khartoum-based MSF staff who acted as supervisor. Training at each site was performed over 3 days by 2 authors (F.G. and F.S.) and included pilot testing of the questionnaires. Questionnaires were forward- and back-translated into Arabic before they were issued, and were delivered orally. The majority of questions required simple yes or no answers or a choice from a list of up to 7 items. We asked the help of neighbors to trace absentees and revisited empty households and households in which children were temporarily absent. Each cluster was completed in 1 working day.

Médecins Sans Frontières and Epicentre do not routinely subject individual standard rapid assessment surveys to formal ethical scrutiny; however, both organizations subscribe to the ethical principles outlined in the Declaration of Helsinki.<sup>3</sup> In addition, the conduct of the study and the content of the questionnaires were reviewed and approved by the local Sudanese authori-

**Figure 1.** Location of Kass, Kalma, and Muhajiria in South Darfur, Sudan



ties (Humanitarian Aid Commission) and were described to IDP community leaders who agreed to and in many cases facilitated the survey. No incentives were offered to participants or officials. The interviewee was the most senior adult household member, who gave oral informed consent to participate in the study. For children aged 6 to 59 months, consent to anthropometric measurement was obtained from a parent or guardian. No names were obtained or recorded except when respondents agreed to the referral of malnourished children or sick individuals to the relevant MSF clinics.

Ages of children were not recalled reliably, and thus the target age range of 6 to 59 months was defined by a height of at least 65 cm and less than 110 cm. A standard United Nations Children's Fund (UNICEF) height board was used and children with a height of less than 85 cm were measured lying down. Weight was determined with a 25-kg Salter scale (UNICEF kit) that was calibrated daily. Acute malnutrition was

said to be present in a child with a weight-for-height ratio  $z$  score of less than  $-2$  compared with the reference population median or if there was pedal edema.

Measles vaccination cards were scarce and vaccination status was based on verbal report by the parents. Access to clean water was defined as the last collection of drinking water having come from a protected well, tap, water bladder, or other chlorinated container. There was a reluctance to show food distribution cards and ownership was assessed by verbal report. Respondents were asked whether they generally used a latrine for defecation. Soap was reported as present by the interviewee or observed by the survey team.

It is customary for mortality data to be collected using a well-defined date to mark the beginning of the recall period. For Kass, the celebration of the birth of the prophet Mohammed on April 30, 2004 (a national holiday in Sudan), was chosen and gave a recall period of 121 days. For Kalma and Muhajiria, a shorter recall period (30 days) was dictated by the priorities of the operational teams. Following a death in Sudan, the custom is to mourn the de-

ceased for a period of 40 days. This period is punctuated by ceremonies of remembrance and the days following a death are reliably counted by the family of the deceased. For each death, we noted the age of the person who died and coded the reported cause as violence, diarrhea, or other (includes multiple other causes of death, such as pneumonia, measles, injuries, and tumors). For diarrhea, we used the standard definition of 3 or more loose stools per 24 hours. Interviewees were asked to report household size and the number of children younger than 5 years; this information was used to determine the denominator for mortality calculations.

We entered data into EpiData version 3.0 (EpiData Association, Odense, Denmark). Analyses were performed using EpiNut (EpiInfo version 6.04; Centers for Disease Control and Prevention, Atlanta, Ga) and Stata version 7.0 (StataCorp, College Station, Tex). Ninety-five percent CIs were calculated and adjusted for the design effect.

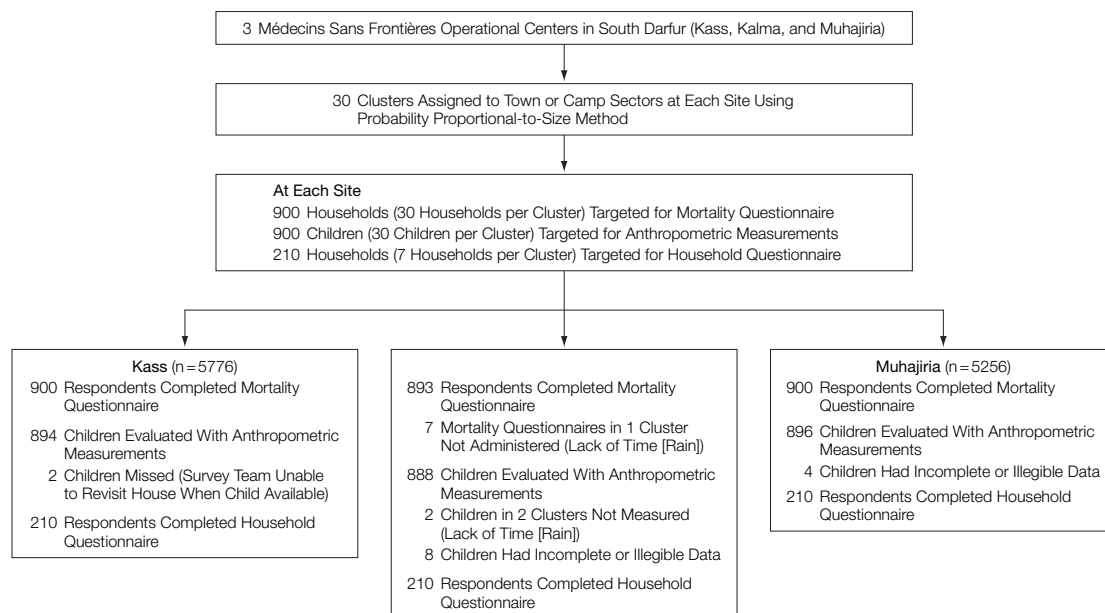
## RESULTS

Surveys were performed from August 26-30, 2004, in Kass; September 2-6,

2004, in Kalma; and September 11-15, 2004, in Muhajiria. There were no recorded cases of refusal to take part in the survey. The main characteristics of the surveyed population are described in TABLE 1. Two hundred seventeen deaths were reported over the previous 121 days in Kass; and in Kalma and Muhajiria, there were 30 and 36 deaths over the 30 days prior to the survey. The crude mortality rates at all 3 sites were considerably higher than the 1 per 10 000 per day that is recognized internationally as defining an emergency situation<sup>4,5</sup> and 4 to 6 times the expected rate in sub-Saharan populations (crude mortality rate, 0.5). In both Kass and Kalma, the under 5-year mortality rates exceeded the 2 per 10 000 per day used as the emergency benchmark.

Deaths from medical causes predominated in Kass and Kalma (80% and 90% of deaths, respectively). Diarrheal diseases were responsible for 25% and 47% of all deaths in these 2 sites, affecting mainly children younger than 5 years and adults older than 50 years. Violence was the major cause of death in Muhajiria (72%), with all but 1 of the 25 violent deaths in men. Most violent deaths had occurred during the

**Figure 2.** Sampling Stages for Surveys in Kass, Kalma, and Muhajiria



fighting prior to displacement and were the major factor in determining the excess mortality. In Kass, 18% of deaths were due to violence, and violence was ongoing; in Kalma, 2 (7%) of 30 deaths were violent.

The prevalence of acute malnutrition was high, particularly in Kalma where nearly 24% of children younger than 5 years were affected (TABLE 2). Reported measles vaccination coverage ranged from 46% to 70%. Between 25% and 71% of people reported regularly using latrines; only in Kalma did a high proportion have access to clean drinking water; soap was scarce. In Muhajiria, where 13 000 displaced people had arrived in the previous month, there had as yet been no distribution of food or essential household items, such as plastic sheeting.

## COMMENT

The 3 surveys, all performed under difficult and insecure field conditions, represent 190 000 people, including 47% of the 289 000 IDPs estimated to be residents in South Darfur in September 2004.<sup>6</sup> Despite relief efforts in Kass and Kalma, both crude and under 5-year mortality rates were well above the benchmark emergency thresholds and a high proportion of deaths were reported to be from diarrhea. In Muhajiria, adult mortality was high and the majority of the deaths were violent. Acute childhood malnutrition at all 3 sites was equal to or more than the 10% defined as "serious".<sup>5</sup> A large proportion of households had access to food and nonfood items but many still lacked access to safe water and sanitation.

We used a 2-stage cluster design for the surveys. Although this increases the sample size required, it is the most practical solution in the absence of a nominative list of refugees that would have allowed for random sampling. The studies were designed with a large sample size to account for the anticipated heterogeneity between clusters (design effect of 2) and met the 5 criteria for validity and precision previously described for nutritional assessments conducted during complex emergencies.<sup>7</sup>

Surveys such as these have important and well-defined limitations.<sup>8</sup> Our survey could not include households in which all members died, which may underestimate the mortality rate. As food distribution relates to the size of the family, we cannot exclude that some interviewees may have exaggerated the size of the household or underreported the number of deaths. However, field teams were specifically trained not to count deaths that occurred before the study period, and the

short recall periods used for both Kalma and Muhajiria should have minimized recall bias.

Mortality rates in refugee situations are commonly compared with the emergency threshold, which is calculated as twice the normal mortality rate for the region (in this case sub-Saharan Africa); hence, the reason for using 1 per 10 000 per day in our analyses. An alternative might be to compare our rates with background rates in Darfur. A region-wide survey undertaken by Save the

**Table 1.** Survey Profiles and Mortality Rates by Age Group and South Darfur Location

	South Darfur Location		
	Kass	Kalma	Muhajiria
Estimated population, No. (IDP%)	77 749 (63)	65 843 (100)	46 850 (48)
No. of households sampled	900	893	900
Population sampled, No.	5776	5050	5256
Children <5 y, No. (%)	1217 (21.9)	1214 (24.2)	1354 (25.9)
Household size, No. mean (range)*	6.2 (1-30)	5.6 (1-23)	5.8 (1-26)
No. of deaths			
Total†	217	30	36
<5 y	90	13	4
Mortality rate (95% CI), per 10 000 per d‡			
Crude	3.2 (2.2-4.1)	2.0 (1.3-2.7)	2.3 (1.2-3.4)
<5 y	5.9 (3.8-8.0)	3.5 (1.5-5.7)	1.0 (0.03-1.9)
Causes of death, No./total No. (%)			
Diarrhea	55/217 (25.3)	14/30 (46.7)	5/36 (13.9)
Violence	39/217 (18.0)	2/30 (6.7)	26/36 (72.2)
Other	118/217 (54.4)	13/30 (43.3)	5/36 (13.9)

Abbreviations: CI, confidence interval; IDP, internally displaced person.

\*There were 39 single-person households in Kass, 23 in Kalma, and 26 in Muhajiria.

†Recall period was 121 days for Kass and 30 days for both Kalma and Muhajiria.

‡Calculated using mid-point population (population at the time of the survey + ½[number of deaths]) as the denominator; 5667, 5035, and 5238 in Kass, Kalma, and Muhajiria, respectively. Design effects for estimates of crude mortality rate were 5.0, 0.9, and 2.3 in Kass, Kalma, and Muhajiria, respectively; and for under 5-year mortality rates, 2.9, 1.1, and 0.9, respectively.

**Table 2.** Childhood Malnutrition and Access to Food and Basic Services by South Darfur Location

	South Darfur Location		
	Kass	Kalma	Muhajiria
Children aged 6-59 mo			
Sample size, No.	894	888	896
Prevalence of malnutrition, % (95% CI)*	14.1 (11.2-17.0)	23.6 (20.2-27.1)	10.7 (8.2-13.3)
Measles vaccination history, % (95% CI)	69.6 (58.8-80.4)	45.7 (36.6-54.9)	50.6 (43.2-57.8)
Access to food and basic services in 210 households, No. (%)†			
Access to clean water	122 (58.1)	200 (95.2)	39 (18.6)
Use of latrine	149 (71.0)	93 (44.3)	53 (25.2)
Presence of soap	71 (33.8)	66 (31.4)	79 (37.6)
Family food distribution card	159 (75.7)	206 (98.1)	‡

Abbreviation: CI, confidence interval.

\*Malnutrition was defined as a weight-for-height ratio z score of less than -2. Data include 1 case of pedal edema in a child in Muhajiria. The design effects attached to these estimates were all 1.4.

†See "Methods" section for explanation of access to food and basic services.

‡No registration for food distribution had been implemented in Muhajiria at the time of the survey.

Children Fund-United Kingdom in 2001<sup>9</sup> estimated the crude mortality rate of residents and IDPs to be 1.0 and 1.4, respectively. Compared with these data, our estimates are high.

Children younger than 5 years are more likely to die of communicable diseases, and these deaths are inextricably linked with their underlying nutritional status. In Muhajiria, childhood mortality and the incidence of malnutrition were both relatively low and likely reflect the recent displacement of many of the families interviewed, with childhood health still close to predisplacement levels. In Kalma, malnutrition was well above even the "critical" threshold of 15%.<sup>5</sup> In this case, IDPs had no access to cultivated land or to food other than that provided in the general food distributions performed by international aid agencies. Although 98% of residents had registration cards at the time of the survey, distributions in the area had been sporadic.

Deaths from diarrhea are likely to reflect inadequate environmental sanitation. This is supported by the reports of poor access to safe water and latrines and low ownership of soap in our surveys as well as direct observation by the field teams of conditions in IDP settlements. In Kass, a measles outbreak documented by MSF in June 2004 may have contributed to the high under 5-year mortality rate at this site and

prompted a measles campaign run by UNICEF. Low background levels of measles vaccination have been documented in Darfur<sup>9</sup>; inadequate coverage in the June 2004 measles campaign in Kass and the huge growth of Kalma camp since the June 2004 campaign may account for the low vaccination coverage reported herein. Muhajiria is in rebel-held territory and was not included in the measles campaign. Inadequate primary health care, which was not directly evaluated by our survey, is also likely to contribute to deaths from medical causes.

In September 2004 in 3 of the major IDP settlements in South Darfur, living conditions for people affected by the conflict were still precarious and clearly met the criteria for a humanitarian emergency. Very similar situations were documented in West Darfur in June and July 2004.<sup>10</sup> Although food distributions in the main centers and at least in 2 sites (Kass and Kalma) were improved as a result of this and other surveys, the recent news from South Darfur is not encouraging. Regular measles catch-up campaigns are not favored by local authorities who advocate that regular Expanded Program of Immunization schedules should be sufficient, and there is serious risk of measles outbreaks in IDP settlements. Security is deteriorating and there are constant new arrivals of IDPs to the camps.

As of February 2005, the World Food Program food registration data for the population of Kalma stood at 150 000. After recent violence in the region, the population of Muhajiria has scattered throughout the surrounding area. Violent attacks are reported frequently by those individuals who stray from the camps to farm or collect fire wood. Additional efforts from humanitarian and governmental actors are urgently needed to guarantee acceptable living standards for these populations.

**Author Contributions:** Dr Sanderson had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study concept and design:** Grandesso, Sanderson, Koene, Brown.

**Acquisition of data:** Grandesso, Sanderson, Kruijt. **Analysis and interpretation of data:** Grandesso, Sanderson.

**Drafting of the manuscript:** Grandesso, Sanderson. **Critical revision of the manuscript for important intellectual content:** Sanderson, Kruijt, Koene, Brown. **Statistical analysis:** Grandesso, Sanderson.

**Obtained funding:** Brown.

**Administrative, technical, or material support:** Koene. **Study supervision:** Sanderson, Brown.

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**Role of the Sponsor:** Médecins Sans Frontières was involved in the design and conduct of the study and the review of the manuscript. Médecins Sans Frontières did not participate in the collection, management, analysis, and interpretation of the data, or the preparation and approval of the manuscript.

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there are improved treatment trials for both pharmacological and nonpharmacological interventions, clinicians may be best advised to vigilantly assess for potentially treatable symptom clusters in their patients with dementia.

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**To the Editor:** The Clinical Review by Dr Sink and colleagues<sup>1</sup> erroneously presents the results of one of the cited studies.<sup>2</sup> On page 602, the article states “. . . the intention-to-treat analysis found only the 16-mg/d dose to be significantly better than placebo . . . with no benefit for the other doses,” using the Neuropsychiatric Inventory as the outcome. In fact, both the 16-mg/d and the 24-mg/d galantamine doses were found to be significantly better than placebo for the Neuropsychiatric Inventory as well as for all other outcome measures.<sup>2</sup>

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1. Sink KM, Holden KF, Yaffe K. Pharmacological treatment of neuropsychiatric symptoms of dementia: a review of the evidence. *JAMA*. 2005;293:596-608.
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**In Reply:** We agree with the points raised by Drs Steinberg and Lyketsos. Most of the drug trials for neuropsychiatric symptoms enrolled patients with very heterogeneous symptoms and measured outcomes with composite symptom scores, such as the Neuropsychiatric Inventory or the Behavioral Pathology

in Alzheimer Disease rating scale (BEHAVE-AD). This design may result in dilution of therapeutic benefits for certain symptom clusters. However, there have not been trials designed to assess the efficacy of drugs for specific symptom clusters. In addition, subgroup analyses have not consistently supported the hypothesis that selected drug therapy for specific symptom clusters is effective. For example, in a post hoc analysis of a trial comparing haloperidol with trazodone, improvement from haloperidol measured by the Cohen-Mansfield Agitation Inventory was not related to the severity of psychotic symptoms, although improvement from trazodone was associated with baseline depressive symptoms.<sup>1</sup> Prospective trials of drug therapy targeting specific symptom clusters or “syndromes” are needed.

Dr Tariot suggests we made an error in reporting the results of a trial of galantamine.<sup>2</sup> We based our statement on the findings of a Cochrane systematic review.<sup>3</sup> Indeed, the results reported in the original article and in the Cochrane review differ slightly. The analysis of the mean change in Neuropsychiatric Inventory scores performed in the Cochrane review found the weighted mean difference between 24-mg galantamine and placebo in the intention-to-treat analysis to be 2.0 points ( $P=.06$ ). The article by Tariot et al<sup>2</sup> reports the same mean difference with  $P<.05$ . Regardless of these small differences in the probability of a type I error, a mean difference of 2 points (on a scale of 0-120) is unlikely to be clinically significant; therefore, our conclusions would not change.

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## CORRECTION

**Error in Figure:** In the Brief Report entitled “Mortality and Malnutrition Among Populations Living in South Darfur, Sudan: Results of 3 Surveys, September 2004” published in the March 23/30, 2005, issue of *JAMA* (2005;293:1490-1494), there was an omission in Figure 2. On page 1492, the middle of the 3 boxes in the last row of the figure should have stated “**Kalma** (n=5050)” as the heading.