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Socio-demographic and health associations with body mass index at the time of enrollment in HIV care in Nyanza Province, Kenya

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Abstract

Low BMI at time of enrollment into HIV care has been shown to be a strong predictor of mortality independent of CD4 count. This study investigated socio-demographic associations with underweight (BMI<18.5) among adults in Nyanza Province, Kenya upon enrollment into HIV care. BMI, socio-demographic, and health data from a cross-sectional sample of 8,254 women and 3,533 men were gathered upon enrollment in the Family AIDS Care and Education Services (FACES) program in Nyanza Province, Kenya between January 2005 and March 2010. Overall, 27.4% of adults were underweight upon enrollment in HIV care. Among both women [W] and men [M], being underweight was associated with younger age (W: adjusted odds ratio [AOR] 2.90; 95% confidence interval [CI] 1.85-4.55; M: AOR, 5.87; 95% CI, 2.80-12.32 for age 15-19 compared to ≥50 years old), less education (W: AOR 2.92; 95% CI, 1.83-4.65; M: AOR, 1.55; 95% CI, 1.04-2.31 for primary education compared to some college/university), low CD4 count (W: AOR 2.13; 95% CI, 1.50-3.03; M: AOR, 1.43; 95% CI, 0.76-2.70 for 0-250 compared to ≥750 cells/mm^3), and poor self-reported health status (W: AOR 1.72; 95% CI, 0.89-3.33; M: AOR, 9.78; 95% CI, 1.26-75.73 for poor compared to excellent). Male gender, lower educational attainment, younger age, and poor self-reported health are associated with low BMI at enrollment into HIV care in Nyanza Province. HIV care and treatment programs should consider using socio-demographic and health risk factors associated with low BMI to target and recruit patients with the goal of preventing late enrollment into care.

Keywords

HIV/AIDS; socio-economic status; anthropometry; body mass index; Kenya; Africa

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Introduction

In sub-Saharan Africa, an estimated 22.5 million adults and children live with HIV/AIDS (UNAIDS, 2010), and an estimated 33% of the general population suffers from malnutrition (Leathers & Foster, 2009). The convergence of HIV/AIDS and undernutrition results in feedback cycles with each amplifying the consequences of the other (Ivers et al., 2009; Weiser et al., 2011). HIV infection contributes to undernutrition by impairing metabolic function and causing malabsorption, poor storage and utilization of nutrients, and increased infections, especially diarrhea (Ivers et al., 2009). Reciprocally, inadequate nutrition accelerates the spread of HIV through increased risk of HIV exposure and infection (Gillespie & Kadiyala, 2005) while also undermining antiretroviral treatment adherence as patients express fears of developing the side effect of increased appetite without enough food to eat (Au et al., 2006).

Low body mass index (defined as BMI<18.5) may reflect both HIV/AIDS disease progression and undernutrition. Critically, low BMI strongly predicts mortality independent of CD4 lymphocyte counts at the time of diagnosis (van der Sande et al., 2004) and enrollment (Argemi et al., 2012). Depression has been shown to be associated with reduced dietary intake in adults living with HIV (Isaac et al., 2008). However, the relationship among socio-economic, demographic, and self-reported health factors in predicting BMI at enrollment in HIV care programs represents a critical link in understanding the relationship between nutrition and HIV that has not yet been well characterized.

As a result of the critical relationship between BMI, HIV/AIDS disease progression, and health-related outcomes, understanding the factors associated with low BMI at enrollment into HIV care can usefully guide treatment and supportive care as well as provide information about targeting and recruiting potential patients. This study focuses on Nyanza Province, the province with the highest HIV prevalence in Kenya at 13.9% (UNAIDS & WHO, 2009). Therefore, in this study, we examine socio-economic, demographic, and disease progression markers associated with low BMI among newly enrolled persons living with HIV/AIDS in Nyanza Province, Kenya. To our knowledge, this is the first study to examine socio-demographic factors associated with BMI at enrollment in care among adults living with HIV/AIDS in sub-Saharan Africa.

Materials and Methods

Study Population

Between January 2005 and March 2010, 14,925 persons living with HIV/AIDS enrolled in 31 clinics through the the Family AIDS Care and Education Services (FACES) program, a collaboration between the Kenya Medical Research Institute (KEMRI) and the University of California, San Francisco (UCSF) in Nyanza Province, Kenya. For this cross-sectional study, we searched the FACES program's OpenMRS (OpenMRS LLC, Indianapolis, Indiana) electronic medical record for all adult patients enrolling into care. Criteria for eligible study participants included being over the age of 15 and enrolling at a FACES clinic. The study was approved by the Ethical Review Committee at KEMRI and the Committee on Human Research at UCSF.

Data collection

At all FACES-supported sites, trained community and clinic health assistants (CCHA) enrolled patients and collected socio-demographic information including age, gender, marital status, highest level of education, and household size using a standardized intake form.

In addition, three self-reported quality of life measures were obtained during enrollment related to health status, daily activity impairment, and feeling 'down or sad' in the past four weeks (Table 1, footnotes d-f). For the latter question, patients were asked, "how much time during the past four weeks have you felt down (low in spirit or sad)?" Patients' height and weight, CD4 T-cell count, and World Health Organization (WHO) adult staging category (WHO, 2007) were also determined at enrollment.

Statistical Analysis

Statistical analyses were conducted with SPSS 12.0 for Windows (SPSS Inc., Chicago, IL). Demographic and anthropometric characteristics between women and men were compared using independent samples T-tests and Pearson's chi-square tests. Univariate logistic regression analyses were performed for underweight with each independent variable. Multivariate logistic regression models included all explanatory variables: age, household size, education, marital status, CD4, WHO stage, health status, health limiting daily activities, and feeling down. All variables were checked for multicollinearity and had a variance inflation factor <2. We calculated 95% confidence intervals (CI) for all odds ratios and reported the p value for the associated logistic regression coefficient. All p values were two-tailed, with the level of significance set at $p<0.05$.

Results

Of the 4,409 men and 10,256 women who enrolled in FACES-supported clinics between 2005 and 2010, anthropometric data were available for 3,533 (80.1%) men and 8,254 (80.5%) women. There were no significant differences in household size, educational attainment, marital status, or CD4 count among respondents with and without available anthropometric data (data not shown). However, among women only, the mean age of those without anthropometric data was slightly older (32.1 years for excluded versus 30.9 years for included, $p=0.006$).

The mean BMI was 21.1± 3.9 for women and 19.7± 2.9 for men (Table 1). Overall, 27.4% of patients who had enrolled in care were underweight (BMI < 18.5), with more men (34.0%) being underweight than women (24.5%) ($p<0.001$). The mean age at enrollment was 30.9 in women and 36.2 in men. The highest level of education for most women (66%) and men (56%) was primary school. The mean CD4 count at enrollment was significantly higher among women (354) than men (271) ($p<0.001$).

Among adults enrolling for HIV care, age, education, CD4 count, WHO stage, self-reported health status, and self-reported health limitations in daily activities were strongly associated with underweight in univariate and multivariate analyses (Table 2). We found no significant associations between underweight and household size, marital status, or feeling down or sad in the past four weeks in multivariate models.

In terms of demographics, compared to women 50 or older, the adjusted odds ratios (AOR) (95% CIs) for underweight increased from 1.03 (0.68-1.54) for women 40-49 to 2.90 (1.86-4.55) for women aged 15-19 ($p<0.001$). This suggests that younger women are more likely to present as underweight as compared to older women. Similarly, compared to men 50 or older, the AOR (95% CIs) for underweight were 5.87 (2.80-12.32) for men aged 15-19 ($p<0.001$). Compared to women whose highest level of education was college or university, the AOR (95% CIs) for underweight increased from 2.29 (1.41-3.71) for women with some secondary education to 4.60 (2.55-8.31) for women with no formal education ($p<0.001$).

As for the health characteristics significantly associated with underweight (Table 2), persons with a CD4 count less than 250 cells/mm^3 (and clinically at a higher risk for opportunistic

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infections) had a 2.13 increased AOR among women and a 1.43 increased AOR among men of being underweight compared to adults with a CD4 count 750 cells/mm^3 or higher (p<0.001). Compared to women with WHO stage 1, the AOR (95% CIs) for underweight increased from 1.71 (1.38-2.12) for women with WHO Stage 2, to 3.48 (2.79-4.35) for women with WHO Stage 3, and 3.66 (2.47-5.43) for women with WHO Stage 4 (p<0.001), with similar findings among men. Adults who reported poor health had nearly a 2-fold increased risk among women and a 10-fold increased risk among men of underweight compared to adults who reported excellent health (p=0.001). Compared to adults who felt no limitations in their daily activities due to health, the AOR (95% CIs) for underweight was 2.44 (1.86-3.20) among women and 2.44 (1.66-3.58) among men who felt health limited their daily activities “a lot” (p<0.001).

Discussion

Overall, 27.4% of adults enrolling in FACES-supported clinics in Nyanza Province had a BMI<18.5. In both sexes, low BMI at enrollment was significantly associated with younger age, less education, decreased CD4 count, advanced WHO stage, poorer self-reported health status, and self-reported health limitations in daily activities. At enrollment, men were older and presented with lower BMI, lower CD4 count, and more advanced WHO Stage than women.

The prevalence of underweight in this population is higher than the general population in Nyanza Province, where 8.8% of women were reported to have a low BMI (Kenya National Bureau of Statistics & ICF Macro, 2010), which may be reflective of higher food insecurity and poverty levels among persons living with HIV/AIDS (Nagata, Magerenge et al., 2011; Nagata, Jew et al., 2011). The high prevalence of underweight may also suggest that HIV-associated wasting may have progressed significantly by the time of enrollment in HIV care. The trend of late enrollment may be more pronounced in men due to the relative unacceptability for males to seek help (Greig & Lang, 2000) and underdevelopment of health services tailored to men compared to reproductive and child health services tailored to women (Collumbien & Hawkes, 2000).

Younger age was significantly associated with lower BMI among both sexes. Adolescents and young adults may be at increased risk for underweight from decreased food allocation due to their low household status and increased energy expenditure from work and household obligations (Foley et al., 2010). However, these explanations are mainly speculative given limited data and therefore an important area of future research.

Individuals with higher education levels may seek health services earlier or have a higher income allowing for the purchase of sufficient food and health care, which may account for their better nutritional status (Villamor et al., 2002). Education at all levels, including at schools and at the community level, have long been identified as central to addressing the HIV epidemic (Aggleton et al., 2012).

Poor self-reported health status and greater self-reported activity impairment were associated with underweight for both men and women living with HIV/AIDS. Men reporting poor health status, the strongest predictor of underweight, were nearly ten times more likely to be underweight than men reporting excellent health status. Adults living with HIV/AIDS appear to be aware of their poor nutritional status and the degree of progression of their illness, which may also contribute to their poor nutritional status. Future research could further explore the contributions of mood and substance issues, such as alcohol and drugs, to poor nutritional status, and the directionality of illness progression and patients’ understanding of their illness. As expected, low BMI was significantly associated with lower

CD4 count and higher WHO stage, indicating that being underweight is correlated with HIV disease progression in our study population.

This study's cross-sectional design precludes any causal inferences. Not all patient charts were complete which accounts for the missing data. In addition, although useful for international comparison, BMI contains some documented limitations in measuring body fat percentage, visceral adipose tissue, and central obesity, particularly among non-European populations (Lear et al., 2007; Rothman, 2008). High levels of undernutrition may have been related to community-level factors as well as HIV disease. However, the large sample size including both urban and rural populations and similar rates of undernutrition reported in Western Province, Kenya and the rest of sub-Saharan Africa (Kuria, 2010; Leathers & Foster, 2009) supports the generalizability of this study's BMI findings.

In summary, this study adds to the literature by identifying male gender, younger age, and lower educational attainment as key determinants of poor nutritional status at enrollment in HIV care. To our knowledge, this is the first study in sub-Saharan Africa to examine the socio-demographic factors associated with BMI among adults living with HIV/AIDS at the time of enrollment in care.

Conclusion

Given that low BMI at enrollment is associated with higher mortality and poorer health outcomes independent of CD4 count (Suttman et al., 1995; van der Sande et al., 2004), it is imperative for patients to enroll into HIV care before their nutritional status significantly declines. Over a third of men and a quarter of women in Nyanza Province enroll into HIV care with a BMI<18.5, indicating significant progression of wasting and decline in nutritional status. Males particularly enroll with poorer nutritional status, older age, and more advanced disease progression, making them a key population to encourage for earlier enrollment through voluntary counseling and testing, community HIV testing campaigns, HIV education, and stigma reduction. Adolescents are also at increased risk to enroll with poorer nutritional status; therefore school or community-based programs targeting this population should be promoted. Future research could further clarify the mechanisms by which adolescents are more likely to enroll with low BMI. Furthermore, interventions to directly improve the nutritional status of underweight persons (Mamlin et al., 2009) and structural interventions that improve food access, such as agricultural production projects (Pandit et al., 2010), may be imperative to the overall success of HIV/AIDS and nutrition support programs.

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Table 1

Anthropometric and socio-demographic characteristics of adults living with HIV/AIDS in Nyanza Province

	Women			Men			Test statistic	P
	Overall	**BMI<18.5**	**BMI ≥ 18.5**	**Overall**	**BMI<18.5**	**BMI ≥ 18.5**		
Number of subjects	8,254	2,026 (24.5%)	6,228 (75.5%)	3,533	1,201 (34.0%)	2,332 (66.0%)		
Anthropometric characteristics								
BMI, mean (SD)	21.1 (3.9)	16.8 (1.3)	22.5 (3.4)	19.7 (2.9)	16.8 (1.3)	21.2 (2.4)	19.58[a]	<0.001
Height, mean (SD), cm	162.7 (7.2)	163.8 (7.8)	162.4 (7.0)	172.4 (7.6)	173.2 (7.6)	172.1 (7.6)		
Weight, mean (SD), kg	56.0 (11.0)	45.2 (5.2)	59.5 (10.0)	58.6 (9.5)	50.5 (5.8)	62.7 (8.2)		
Demographic characteristics								
Age, mean (SD), years	30.9 (9.8)	31.1 (10.4)	30.8 (9.6)	36.2 (10.9)	35.4 (10.6)	36.6 (11.0)	-26.10[a]	<0.001
Household size, mean (SD)	4.5 (7.5)	4.4 (2.3)	4.5 (8.5)	5.0 (12.9)	4.9 (13.6)	5.1 (12.6)	-0.90[a]	0.368
Education, %							220.57[b]	<0.001
None	4.10%	5.6%	3.6%	1.5%	2.0%	1.2%		
Some primary	66.20%	71.9%	64.4%	55.6%	60.8%	53.0%		
Some secondary	24.70%	20.4%	26.1%	33.5%	30.2%	35.1%		
Some college/university	5.00%	2.1%	5.9%	9.5%	6.9%	10.7%		
Marital status, %							1406.31[b]	<0.001
Married	44.0%	40.7%	45.1%	63.3%	58.9%	65.5%		
Not married[c]	56.0%	59.3%	54.9%	36.7%	41.1%	34.5%		
Health characteristics								
CD4, mean (SD)	354.2 (265.3)	260.7 (234.7)	384.3 (268.4)	271.4 (225.6)	199.2 (202.8)	308.9 (227.7)	13.27[a]	<0.001
WHO stage, %							174.66[b]	<0.001
Stage 1	37.3%	18.9%	43.4%	27.3%	12.8%	34.6%		
Stage 2	32.2%	29.3%	33.2%	30.0%	25.6%	32.2%		
Stage 3	27.1%	45.1%	21.2%	37.4%	52.9%	29.5%		
Stage 4	3.3%	6.7%	2.2%	5.3%	8.7%	3.6%		
Health status,[d] %							38.79[b]	<0.001
Excellent	2.2%	1.0%	7.6%	1.1%	0.4%	1.6%		
Very good	6.2%	3.2%	42.8%	5.9%	4.0%	7.5%		

	Women			Men			Test statistic	P
	Overall	BMI<18.5	BMI ≥ 18.5	Overall	BMI<18.5	BMI ≥ 18.5		
Good	35.5%	21.7%	39.9%	32.1%	20.9%	41.5%		
Fair	44.6%	50.3%	7.1%	39.8%	47.8%	40.1%		
Poor	11.6%	23.8%	2.6%	14.2%	27.0%	9.2%		
Health limits daily activities,[e] %							61.87[b]	<0.001
Limited a lot	12.7%	24.8%	8.8%	16.0%	31.5%	10.6%		
Limited a little	39.7%	45.4%	37.9%	37.3%	44.8%	39.5%		
Not limited at all	47.6%	29.8%	53.4%	37.0%	23.7%	49.9%		
Felt down or sad in past four weeks,[f] %							14.54[b]	0.002
All of the time	1.1%	3.7%	0.6%	1.5%	3.0%	1.0%		
A lot of the time	6.8%	10.9%	5.4%	6.5%	11.3%	5.2%		
Some of the time	46.3%	49.1%	45.3%	38.4%	46.5%	41.0%		
None of the time	45.9%	37.3%	48.6%	43.2%	39.1%	52.9%		

[a]Independent samples T-test

[b]Pearson's chi square test

[c]Not married includes single, widowed, separated, and divorced

[d]Self-reported response to the question, "in general, would you say your health is excellent, very good, good, fair, or poor?"

[e]Self-reported response to the question, "how much does your health limit you in typical daily activities such as walking places, carrying goods, gardening, and cleaning?"

[f]Self-reported response to the question, "how much time during the past four weeks have you felt down (low in spirit or sad)?"

Table 2

Odds ratios for determinants of BMI<18.5 in adults living with HIV/AIDS in Nyanza Province, Kenya

	Women					Men				
		Odds ratio (95% confidence interval)					Odds ratio (95% confidence interval)			
Determinants	n[a]	Univariate	P	Multivariate[b]	P	n[c]	Univariate	P	Multivariate[b]	P
Age			0.001		<0.001			<0.001		<0.001
15-19	528	1.02 (0.77-1.34)		2.90 (1.85-4.55)		97	3.05 (1.94-4.78)		5.87 (2.80-12.32)	
20-29	3,861	0.72 (0.58-0.90)		1.53 (1.07-2.19)		907	1.20 (0.94-1.53)		1.52 (1.02-2.28)	
30-39	2,378	0.74 (0.60-0.93)		1.13 (0.78-1.63)		1,350	1.23 (0.98-1.56)		1.27 (0.87-1.85)	
40-49	1,027	0.78 (0.61-0.99)		1.03 (0.68-1.54)		740	1.10 (0.85-1.42)		1.26 (0.84-1.89)	
≥50	460	1.00 (Referrent)		1.00 (Referrent)		439	1.00 (Referrent)		1.00 (Referrent)	
Household size			0.508		0.93			0.07		0.82
1	506	1.00 (Referrent)		1.00 (Referrent)		405	1.00 (Referrent)		1.00 (Referrent)	
2-3	2,545	0.90 (0.73-1.12)		1.00 (0.72-1.39)		856	1.07 (0.83-1.37)		1.17 (0.80-1.71)	
4-5	2,677	0.85 (0.68-1.06)		1.03 (0.74-1.43)		1,037	1.08 (0.85-1.37)		1.11 (0.76-1.63)	
≥6	1,964	0.90 (0.72-1.13)		0.96 (0.68-1.35)		1,034	0.86 (0.67-1.10)		1.05 (0.71-1.56)	
Education			<0.001		<0.001			<0.001		<0.01
None	304	4.45 (2.95-6.72)		4.60 (2.55-8.31)		47	2.70 (1.44-5.06)		3.75 (1.46-9.63)	
Some primary	4,930	3.14 (2.24-4.42)		2.92 (1.83-4.65)		1,794	1.78 (1.35-2.35)		1.55 (1.04-2.31)	
Some secondary	1,838	2.20 (1.54-3.14)		2.29 (1.41-3.71)		1,079	1.33 (1.00-1.78)		1.21 (0.80-1.83)	
Some college/university	373	1.00 (Referrent)		1.00 (Referrent)		305	1.00 (Referrent)		1.00 (Referrent)	
Marital status			0.001		0.84			<0.001		0.19
Married	3,630	1.00 (Referrent)		1.00 (Referrent)		2,235	1.00 (Referrent)		1.00 (Referrent)	
Not married*	4,624	1.20 (1.08-1.32)		1.02 (0.86-1.20)		1,298	1.33 (1.15-1.53)		1.17 (0.93-1.49)	
CD4			<0.001		<0.001			<0.001		<0.01
0 - 249	2,273	3.56 (2.68-4.72)		2.13 (1.50-3.03)		1,285	2.69 (1.62-4.47)		1.43 (0.76-2.70)	
250 - 499	1,858	1.55 (1.16-2.08)		1.28 (0.89-1.83)		703	1.13 (0.67-1.92)		1.07 (0.56-2.04)	
500 - 749	906	1.28 (0.92-1.77)		1.16 (0.78-1.71)		274	0.89 (0.50-1.59)		0.75 (0.37-1.52)	
≥750	478	1.00 (Referrent)		1.00 (Referrent)		91	1.00 (Referrent)		1.00 (Referrent)	
WHO stage			<0.001		<0.001			<0.001		<0.001
Stage 1	2,829	1.00 (Referrent)		1.00 (Referrent)		888	1.00 (Referrent)		1.00 (Referrent)	

	Women					Men				
		Odds ratio (95% confidence interval)					Odds ratio (95% confidence interval)			
Determinants	**n[a]**	**Univariate**	**P**	**Multivariate[b]**	**P**	**n[c]**	**Univariate**	**P**	**Multivariate[b]**	**P**
Stage 2	2,443	2.03 (1.76-2.35)		1.71 (1.38-2.12)		976	2.14 (1.71-2.69)		2.15 (1.54-3.00)	
Stage 3	2,053	4.90 (4.25-5.64)		3.48 (2.79-4.35)		1,217	4.84 (3.91-5.98)		3.54 (2.54-4.92)	
Stage 4	251	6.96 (5.31-9.13)		3.66 (2.47-5.43)		174	6.52 (4.60-9.24)		4.24 (2.56-7.01)	
Health status								<0.001		
Excellent	167	1.00 (Referrent)	<0.001	1.00 (Referrent)	0.001	39	1.00 (Referrent)		1.00 (Referrent)	<0.001
Very good	471	1.23 (0.71-2.15)		0.83 (0.41-1.67)		208	2.35 (0.79-6.96)		5.50 (0.71-42.84)	
Good	2,714	1.47 (0.89-2.42)		0.93 (0.53-1.82)		1,135	2.25 (0.79-6.39)		4.23 (0.56-31.89)	
Fair	3,415	3.16 (1.93-5.19)		1.32 (0.71-2.44)		1,405	5.32 (1.88-15.04)		6.39 (0.85-48.32)	
Poor	887	8.41 (5.07-13.96)		1.72 (0.89-3.33)		501	13.06 (4.57-37.31)		9.78 (1.26-75.73)	
Health limits daily activities			<0.001		<0.001			<0.001		<0.001
Limited a lot	948	5.07 (4.33-5.92)		2.44 (1.86-3.20)		564	6.23 (5.06-7.81)		2.44 (1.66-3.58)	
Limited a little	2,963	2.15 (1.90-2.43)		1.39 (1.15-1.68)		1,317	2.40 (2.01-2.86)		1.52 (1.15-2.01)	
Not limited at all	3,549	1.00 (Referrent)		1.00 (Referrent)		1,306	1.00 (Referrent)		1.00 (Referrent)	
Felt down or sad in past four weeks			<0.001		0.21			<0.001		0.84
All of the time	81	5.31 (3.39-8.30)		1.77 (0.87-3.61)		52	4.30 (2.43-7.60)		1.39 (0.52-3.71)	
A lot of the time	504	2.61 (2.15-3.18)		1.08 (0.77-1.52)		229	2.96 (2.23-3.92)		1.04 (0.64-1.68)	
Some of the time	3,443	1.41 (1.26-1.58)		0.92 (0.77-1.09)		1,355	1.53 (1.31-1.79)		0.95 (0.74-1.21)	
None of the time	3,416	1.00 (Referrent)		1.00 (Referrent)		1,526	1.00 (Referrent)		1.00 (Referrent)	

[a] Totals may be less than 8 254 due to missing data

[b] To obtain multivariate adjusted odds ratios, a logistic regression model included all explanatory variables: age, household size, education, marital status, CD4, WHO stage, health status, health limits daily activities, felt down

[c] Totals may be less than 3 533 due to missing data

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