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Exploring the role of social vulnerability on maternal and perinatal outcomes: an analysis from two multicenter Brazilian cohorts (preliminary results)

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INTRODUCTION:

Social vulnerability (SV) is defined as a set of multidimensional risk factors resulting from limited access to material and social resources, which compromise well-being and resilience in the face of illness[1,2]. Higher levels of SV are associated with a person's frailty and poorer ability to overcome or prevent illness, besides its independent correlation to worse clinical outcomes and higher mortality rates[3,4]. In pregnancy, a growing body of evidence reports that the maternal and parental social context has a crucial influence on pregnancy outcomes and the health status of newborns[5–7].

While its relevance to the health–illness process in pregnant women is well documented, measuring SV remains a challenge due to its intersection with sociodemographic characteristics, partner and family dynamics, economic hardship, and self-perception of social roles[8]. Attempts to operationalize SV range from neighborhood-level deprivation indices[9–12] to retrospective analyses of individual patient data[6,13], yet most tools are not specific to pregnancy nor easily generalized across national contexts.

Given this complexity, we aimed to investigate the impact of individual SV indicators on maternal and perinatal outcomes in two large multicenter Brazilian cohorts, as an empirical foundation for the development of an internal Social Vulnerability Index (SVI) tailored to obstetric care.

METHODS:

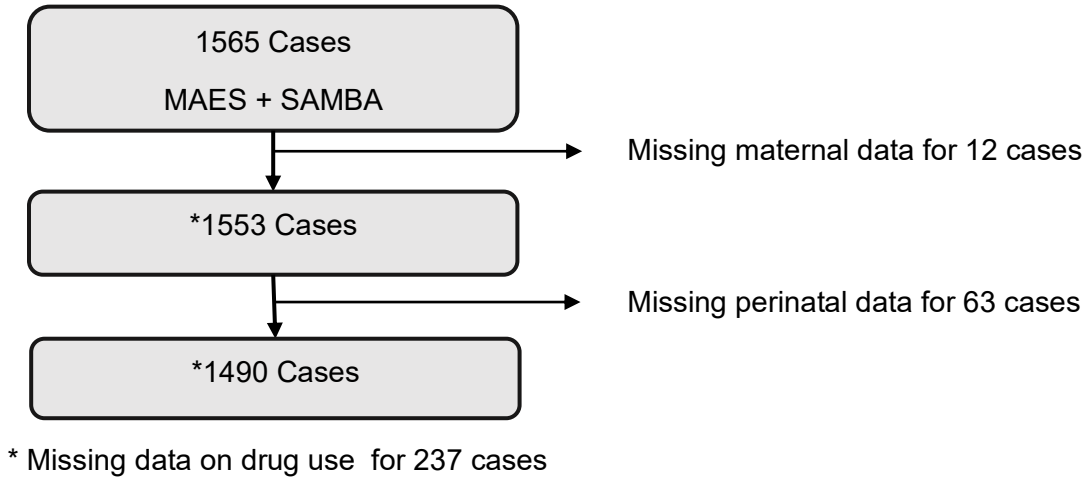
This is a secondary analysis of two previously conducted Brazilian cohort studies - Preterm SAMBA[14] and MAES-I[15] - with the specific objective of defining and stratifying a Social Vulnerability Index (SVI) tailored to Brazilian pregnant women. Using a total of 1,565 cases of low-risk pregnant nullipara women included at mid-pregnancy and followed until childbirth, we aim to develop an internal SVI based on self-

reported sociodemographic data and evaluate its distribution and association with adverse maternal and perinatal outcomes. After exclusion of incomplete records, 1,553 cases were included in the maternal outcome analysis and 1,490 in the perinatal outcome analysis (Fig.1).

Social vulnerability indicators were selected from the original questionnaires and included maternal age (<20 or >34 years), ethnicity (non-white), education (<12 years of schooling), income (<6,000 BRL/year), marital status (no partner), living status (alone), employment status (unemployed), drug use during pregnancy, and type of prenatal care (public only).

Maternal outcomes included Preterm birth (PTB), Gestational diabetes mellitus (GDM), Preeclampsia (PE) and the composite any maternal adverse outcome (AMO) as described above. Perinatal outcomes encompassed small or large for gestational age (SGA/LGA), low 5-minute Apgar score, neonatal intubation, NICU admission, fetal or neonatal death, and the composite any adverse perinatal outcome (APO) as described above.

Figure 1. Flowchart of the population included in the study



We initially evaluated individual associations between SV indicators and outcomes using chi-square tests and risk ratios (RR) with 95% confidence intervals (Table 1). To identify redundancy and collinearity among variables, compound indicators were created and analyzed using cross-tabulations and chi-square testing (currently being finalized). This exploratory process will guide the selection of statistically relevant variables for inclusion in a preliminary version of the SVI.

Each variable will be coded as 0 (absent) or 1 (present), and the cumulative SVI score will be calculated by summing the binary values for each subject. Social vulnerability will then be stratified into low, moderate, or high degrees, based on the burden (statistical significance and risk magnitude) and total number of vulnerability conditions. Associations between SVI degrees and maternal/perinatal outcomes

will be tested in a subsequent phase. All analyses were performed using IBM SPSS Statistics (Version 21.0).

RESULTS AND DISCUSSION

This session presents the associations between individual social vulnerability indicators and adverse maternal and perinatal outcomes. Findings are structured by outcome type and discussed in the context of relevant literature on maternal health and social determinants.

Table 1. Estimated risks of AMO and APO according to some sociodemographic characteristics

Sociodemographic characteristics		AMO (n = 1553)					APO (n = 1490)				
		Yes	No	RR	CI (95%)	p-Value	Yes	No	RR	CI (95%)	p-Value
Maternal age	<20 years	70	308	**0.761**	**0.602 - 0.964**	**0.020**	124	234	1.069	0.905 - 1.263	0.435
	20 - 34 years	269	837	Ref.			345	720	Ref.		
	> 34 years	27	42	**1.609**	**1.178 - 2.198**	**0.006**	20	47	0.921	0.632 - 1.344	0.666
Marital status	Without partner	101	321	1.021	0.836-1.248	0.835	143	260	1.115	0.952 - 1.305	0.182
	With partner	265	866	Ref.			346	741	Ref.		
Living status	Alone	5	25	0.703	0.314 - 1.573	0.369	7	21	0.758	0.398 - 1.446	0.374
	Accompanied	361	1162	Ref.			482	980	Ref.		
Ethnic group	Other	243	723	**1.200**	**0.992 - 1.453**	**0.059**	324	596	**1.217**	**1.041 - 1.421**	**0.012**
	White	123	464	Ref.			165	405	Ref.		
Years of study	<12 years	254	842	0.946	0.779 - 1.148	0.573	352	701	1.066	0.960 - 1.255	0.437
	>12 years	112	345	Ref.			137	300	Ref.		
Anual income (Cat 6 mil)	< 6,000 Reais	37	94	1.221	0.914 - 1.630	0.187	38	87	0.920	0.698 - 1.212	0.547
	> 6,000 Reais	329	1093	Ref.			451	914	Ref.		
Anual income (Cat 12 mil)	< 12,000 Reais	102	335	0.987	0.808 - 1.205	0.895	131	283	0.951	0.806 - 1.122	0.549
	> 12,000 Reais	264	852	Ref.			358	718	Ref.		
Labor Activity	Unemployed	202	632	1.062	0.887 - 1.272	0.514	253	555	0.905	0.783 - 1.046	0.178
	Employed	164	555	Ref.			236	446	Ref.		
Type of PN care	Only public	331	1035	**1.295**	**0.947 - 1.771**	**0.096**	443	866	**1.332**	**1.026 - 1.728**	**0.024**
	Other	35	152	Ref.			46	135	Ref.		
Use of any drugs*	Current or During pregnancy	72	220	1.026	0.817 - 1.289	0.823	93	187	1.051	0.869 - 1.270	0.612
	Never	246	778	Ref.			312	675	Ref.		

* Missing data for 237 cases

**1 cell have expected count less than 5.

Advanced maternal age (>34 years) was associated with increased risk for any maternal adverse outcome (RR 1.61; 95% CI 1.18–2.20), while adolescent pregnancy (<20 years) showed a protective association (RR 0.76; 95% CI 0.60–0.96). Women receiving exclusively public prenatal care had borderline non-significant increased risk of maternal adverse outcomes (RR 1.30; 95% CI 0.95–1.77; p = 0.096).

Regarding perinatal outcomes, non-white ethnicity was significantly associated with increased risk of adverse events (RR 1.22; 95% CI 1.04–1.42), as was public-only prenatal care (RR 1.33; 95% CI 1.03–1.73). Additional analyses showed that women ≥35 had a higher risk of developing gestational diabetes mellitus (RR 1.88; 95% CI 1.12–3.16), while adolescents had a significantly lower risk (RR 0.45; 95% CI 0.27–0.74). No significant associations were observed between other individual indicators (education, marital status, income, drug use) and adverse outcomes.

These findings reinforce prior evidence that social vulnerability contributes to disparities in maternal and neonatal outcomes, particularly through structural and systemic mechanisms[5–7]. Associations identified for maternal age, non-white ethnicity, and public-only prenatal care suggest overlapping domains of disadvantage with biological, institutional, and relational components.

Although not all individual indicators were statistically significant in isolation, their recurring trends support the rationale for a composite measure. A multidimensional Social Vulnerability Index (SVI) may better capture the cumulative burden of risk, offering improved predictive value over isolated variables. This approach aligns with international efforts to quantify social determinants through validated indices and may guide more equitable prenatal risk stratification in Brazil.

Ongoing analyses will refine the SVI using multivariate models and assess its performance in predicting maternal and neonatal morbidity.

CONCLUSIONS:

This study represents the initial phase of an ongoing effort to develop a Social Vulnerability Index (SVI) tailored to Brazilian pregnant women. Our findings identified consistent associations between maternal age, ethnicity, and public prenatal care with adverse maternal and perinatal outcomes, highlighting key structural and demographic determinants that demand further investigation.

While the current analysis focused on individual indicators, the next phase involves constructing a composite index by integrating these variables, assessing their cumulative burden, and validating the SVI through multivariate modeling. These steps are essential to evaluate its predictive performance and applicability in prenatal risk stratification.

Although limited by the exploratory nature, number of cases and context-specific data, our approach aligns with global efforts to incorporate social determinants into clinical care. By translating complex vulnerability profiles into actionable tools, this work aims to inform equitable maternal health policies and strengthen decision-making in public health systems.

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