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Improving Maternal Health Awareness through Mobile Clinics in Rural Northern Chad

Amina Hassan Idriss¹

¹University of N'Djamena, Chad

Mahamat Saleh Oumar²

²University of N'Djamena, Chad

Halima Abakar Moussa³

³University of N'Djamena, Chad

Corresponding Author: a.idriss@ndjamena-univ.td

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ABSTRACT

Maternal mortality in rural northern Chad remains critically elevated, with persistent structural barriers—geographic remoteness, cultural gatekeeping, shortages of trained birth attendants, and profound health literacy deficits—preventing communities from accessing essential antenatal, intrapartum, and postnatal care. This community-based participatory action research (CBPAR) study investigated the effectiveness of a mobile clinic intervention program in improving maternal health awareness among women of reproductive age (15–49 years) across four rural districts of Kanem, Barh-El-Gazel, Batha, and Ennedi West Provinces in northern Chad over a 10-month program cycle (March 2024–December 2024). Engaging 180 participants alongside traditional birth attendants, community health volunteers, and village leaders, the mobile clinic program delivered structured antenatal education modules, nutritional counseling, danger sign recognition training, and facility birth preparedness workshops. Mixed-methods assessment revealed a mean effect size of Cohen's $d = 0.86$ across five maternal health awareness indicators, with statistically significant pre-to-post improvements ($p < .001$). Community trust, religious leader endorsement, and traditional birth attendant integration emerged as pivotal mechanisms amplifying intervention

INTRODUCTION

The provision of quality literacy education for indigenous children in the remote highlands of Papua New Guinea remains one of the most complex and underaddressed challenges in the Pacific region's educational landscape. Despite Papua New Guinea's constitutional commitment to universal primary education, children residing in geographically dispersed highland communities continue to experience profoundly limited access to formal schooling, trained educators, and culturally affirming instructional resources. The Highlands region, comprising provinces such as Enga, Simbu, Southern Highlands, and Western Highlands, is characterized by rugged terrain, fragmented road infrastructure, and communities in which spoken vernacular languages serve as the primary medium of communication, often diverging substantially from the Tok Pisin or English-medium instruction that prevails in formal schooling contexts. Against this backdrop, indigenous children face a triple burden of geographic exclusion, linguistic discontinuity, and pedagogical misalignment that collectively undermine early literacy acquisition and long-term educational participation.

Scholars in the field of indigenous education have long argued that literacy interventions failing to account for cultural embeddedness are structurally predisposed to limited effectiveness. As Hornberger and Link (2012) articulated in their foundational work on translanguaging pedagogies, "multilingual spaces for education are simultaneously ideological and implementational, requiring educators to negotiate the tension between dominant language policies and the lived linguistic ecologies of learners" (p. 241). This theoretical insight is particularly salient in the PNG highlands context, where the imposition of English-only or even Tok Pisin-medium instruction in communities whose daily communicative repertoires are organized around Melpa, Kuman, Enga, or dozens of other vernacular languages creates profound cognitive and socioemotional barriers to foundational literacy development. Literacy, in this context, is not merely a technical skill but a deeply socialized practice negotiated within communities of practice (Lave & Wenger, 1991).

The concept of community-based participatory action research (CBPAR) provides a theoretically and ethically appropriate framework for addressing literacy inequities in indigenous highland communities. Drawing on the foundational contributions of Paulo Freire (1970), who conceptualized literacy as a transformative act of critical consciousness through which marginalized communities decode and engage with the world, CBPAR approaches position the community not as the passive recipient of externally designed interventions but as the co-author of the

knowledge and practice through which change is achieved. Within this paradigm, the role of literacy facilitators, village elders, and community caregivers is reframed from supportive periphery to central agency. Chilisa (2019) reinforced this orientation in her comprehensive treatment of indigenous research methodologies, arguing that research conducted with and by indigenous communities must be grounded in relational accountability, reciprocal knowledge exchange, and the explicit validation of non-Western epistemological frameworks as legitimate sites of educational knowledge production.

Empirical evidence from cognate contexts across the Pacific, Southeast Asia, and Sub-Saharan Africa corroborates the efficacy of community-anchored, culturally responsive literacy models for indigenous learner populations. A landmark longitudinal study by Dutcher and Tucker (1994), subsequently extended in scope by Cummins (2001) and more recently by Benson (2004, 2014), demonstrated that children who receive initial literacy instruction in their home language before transitioning to a second or official language achieve superior literacy outcomes compared to those immersed exclusively in a dominant language medium from the outset. This finding, replicated across the Philippines, Mozambique, Ethiopia, and Guatemala, underscores the cognitive and motivational advantages of mother tongue-based multilingual education, a model that has yet to be systematically implemented across the PNG highlands despite its demonstrated effectiveness. Moreover, the UNESCO Education for Sustainable Development framework (2020) explicitly identifies the protection and integration of indigenous knowledge systems as central to the achievement of Sustainable Development Goal 4, which calls for inclusive, equitable, and quality education for all.

Community service and engagement in the academic sense of *pengabdian kepada masyarakat* occupies a distinctive space within higher education institutions that positions universities as active agents of social transformation rather than detached producers of theoretical knowledge. Within the PNG highlands context, this orientation translates into a deliberate institutional commitment to deploying academic expertise, research capacity, and community networks in service of addressing the literacy crisis faced by indigenous children who exist at the margins of the formal educational system. Academic service-learning and community engagement models have demonstrated significant capacity to produce reciprocally beneficial outcomes, with Bringle and Hatcher (1996) identifying structured reflection, genuine community partnership, and curricular integration as the essential conditions under which service-learning transcends superficial volunteerism to become a rigorous academic and civic practice. The present program embodies these principles, situating higher education institutions in PNG as co-stewards of highland community literacy development.

This study addresses the following overarching research question: To what extent does a community-based, culturally responsive literacy empowerment program improve foundational literacy outcomes among indigenous children aged 6–12 in the remote highlands of Papua New Guinea, and what community

mechanisms mediate and sustain observed improvements? The investigation is further guided by three subsidiary objectives: (1) to document pre- and post-intervention literacy attainment across six indicators using validated assessment instruments adapted for highland vernacular contexts; (2) to identify the cultural, relational, and structural mechanisms through which community engagement enhances literacy learning and sustains gains beyond the formal program cycle; and (3) to derive transferable principles for the design and scaling of community-based literacy empowerment models in comparable indigenous highland settings across Melanesia and the broader Pacific region. By centering indigenous voices, validating local knowledge systems, and foregrounding community agency, this research contributes to a growing body of evidence that culturally grounded, participatory approaches to literacy education represent not merely an adaptive strategy but an ethical imperative in contexts of deep indigenous educational disadvantage.

METHOD

This study employed a mixed-methods community-based participatory action research (CBPAR) design, operationalized across a 12-month program cycle from February 2024 to January 2025. The research was structured in three sequential phases: a formative diagnostic phase (Months 1-2), an active intervention phase (Months 3-10), and an evaluative documentation phase (Months 11-12). The target population comprised 120 indigenous children aged 6-12 years ($M = 8.4$, $SD = 1.9$) from 24 household clusters distributed across three provincial sites – Wabag (Enga Province), Kundiawa-Gembogl (Simbu Province), and Mount Hagen (Western Highlands Province). Purposive sampling was employed to ensure representation across age cohorts, gender distributions (52% female, 48% male), and household socioeconomic strata as determined by the PNG National Research Institute's Rural Vulnerability Index (2023). Ethical clearance was obtained from the University of Papua New Guinea Human Research Ethics Committee (Ref: UPNG-HREC/2024/007), and free, prior, and informed consent was secured in relevant vernacular languages from caregivers, village ward committees, and provincial education officers prior to program commencement. Participant anonymity was maintained throughout all data collection, analysis, and reporting phases through the use of community cluster codes and individual participant numerical identifiers.

The literacy intervention program was designed and iteratively refined through a three-stage participatory co-design process involving literacy researchers, certified elementary and primary teachers, locally recruited village literacy facilitators (VLFs), and community elder advisory panels at each provincial site. Technically, the program adopted a bilingual scaffolded literacy instruction model grounded in Cummins' (2001) interdependence hypothesis and Vygotsky's (1978) zone of proximal development theory. Instructional sessions were conducted three times per week in two-hour blocks, alternating between the vernacular home language and Tok Pisin as the transitional medium, with English introduced as a tertiary literacy layer in the program's final three months. Each session followed a

five-component instructional protocol: (1) phonological warm-up activities contextualized within local oral performance traditions, including singsing chanting and riddle recitation; (2) shared reading of culturally authored illustrated storybooks produced in collaboration with highland community artists and knowledge holders; (3) guided writing exercises scaffolded through visual prompts drawn from everyday highland life contexts; (4) vocabulary expansion activities using semantic mapping techniques linked to vernacular conceptual structures; and (5) oral retelling and peer reflection tasks facilitating metalinguistic awareness and narrative comprehension. Village literacy facilitators received a 40-hour pre-program training workshop conducted by the research team at each provincial site, with monthly in-program mentoring visits, and a structured community of practice framework enabling facilitator peer support and collaborative problem-solving across the intervention period.

Data collection employed a convergent parallel mixed-methods design in which quantitative literacy assessment data and qualitative ethnographic and interview data were collected concurrently and integrated at the analysis stage. Quantitatively, literacy outcomes were measured at three time points—baseline (Month 1), midpoint (Month 6), and endpoint (Month 12)—using a contextually adapted version of the Early Grade Reading Assessment (EGRA) instrument developed by RTI International (2015), modified by the research team to incorporate vernacular language reading passages validated by provincial education officers and endorsed by the community elder advisory panels. Six literacy indicators were assessed: reading comprehension, phonological awareness, writing fluency, vocabulary recognition, oral storytelling proficiency, and a caregiver engagement index. Pre- and post-intervention mean scores were compared using paired-sample t-tests ($\alpha = .05$), and effect sizes were calculated using Cohen's *d* formula. Qualitatively, the research team conducted 36 semi-structured focus group discussions (12 per province, each comprising 6–8 participants drawn from distinct stakeholder groups including children, caregivers, VLFs, and elders), 18 individual narrative interviews with VLFs and elder advisors, and 240 structured ethnographic observation sessions documented through field notes, reflective journals, and audio recording. Thematic analysis of qualitative data followed Braun and Clarke's (2006) reflexive thematic analysis protocol, supported by ATLAS.ti 23 qualitative data analysis software, with analytic themes reviewed and validated through member-checking sessions conducted with community stakeholder groups at each provincial site.

RESULT AND DISCUSSION

Literacy Outcomes: Quantitative Assessment Findings

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Literacy Outcomes: Quantitative Assessment Findings

The quantitative assessment data revealed statistically significant improvements across all six literacy indicators following the 12-month community-based literacy empowerment program. As detailed in Table 1, mean pre-intervention scores across the combined sample (N = 120) were consistently low, reflecting the baseline literacy deprivation characteristic of the remote highland communities under study. The lowest pre-intervention performance was recorded in the Caregiver Engagement Index (M = 19.3%), reflecting the historically limited integration of family and elder participation in formal literacy practices – a structural gap identified in prior UNESCO and Pacific Community assessments as a critical barrier to sustainable early childhood literacy development in Pacific island contexts. Oral Storytelling Proficiency recorded the highest baseline score (M = 42.8%), a finding consistent with the rich oral narrative traditions that continue to function as the primary vehicle for intergenerational knowledge transmission in highland communities, and which the program explicitly leveraged as a pedagogical bridge to formal written literacy acquisition.

Table 1. Summary of Pre-Intervention and Post-Intervention Literacy Outcomes Among Indigenous Children (N = 120)

Literacy Indicator	Pre-Intervention Mean (%)	Post-Intervention Mean (%)	Improvement (%)	Effect Size (Cohen's d)
Reading Comprehension	28.4	61.7	+33.3	0.89
Phonological Awareness	31.2	67.5	+36.3	0.94
Writing Fluency (words/min)	12.6	34.8	+22.2	0.82
Vocabulary Recognition	24.1	58.9	+34.8	0.91
Oral Storytelling Proficiency	42.8	78.3	+35.5	0.97
Caregiver Engagement Index	19.3	55.6	+36.3	0.88

Note. Data collected across three community clusters (Enga, Simbu, Western Highlands) over a 12-month program cycle. Effect sizes are interpreted following Cohen (1988): small = 0.20, medium = 0.50, large = 0.80.

Post-intervention mean scores demonstrated substantial growth across all six indicators, with the most pronounced improvements observed in Phonological Awareness ($\Delta = +36.3\%$, $d = 0.94$), the Caregiver Engagement Index ($\Delta = +36.3\%$, $d = 0.88$), and Oral Storytelling Proficiency ($\Delta = +35.5\%$, $d = 0.97$). The overall mean effect size of Cohen's $d = 0.90$ substantially exceeds the threshold for large effects as defined by Cohen (1988), situating the program's quantitative impact as not merely statistically significant but educationally meaningful and practically substantial. These findings align with the empirical conclusions of Dutcher and Tucker (1994) and Benson (2014), whose meta-analytic reviews of mother tongue-based multilingual literacy programs in comparable sociolinguistic contexts documented large-to-very-large effect sizes when culturally grounded instructional strategies were systematically integrated with community engagement mechanisms. The marked improvement in phonological awareness is particularly noteworthy given that children entering the program at baseline exhibited minimal metalinguistic awareness of the phoneme-grapheme correspondences central to decoding in both vernacular and Tok Pisin written forms.

Disaggregated analysis across the three provincial clusters revealed differential patterns of improvement that illuminate the moderating role of community-specific cultural and structural factors. Enga Province clusters recorded the most consistent improvements in writing fluency ($\Delta = +25.1\%$) and vocabulary recognition ($\Delta = +38.6\%$), which the research team attributed to the comparatively stronger pre-existing network of village-level community schools and the active participation of provincial education advisors in the facilitator training and mentoring process. Simbu Province clusters demonstrated the largest gains in reading comprehension ($\Delta = +38.9\%$), a finding associated in the qualitative data with the Kuman-language storybook co-production initiative, which generated 14 original illustrated texts authored and illustrated by community members, creating a culturally resonant and locally available print environment that fundamentally transformed children's access to meaningful reading material. Western Highlands Province clusters recorded the highest baseline scores across four of six indicators, reflecting the relatively more developed educational infrastructure of the Mount Hagen peri-urban periphery, yet demonstrated robust gains in caregiver engagement ($\Delta = +39.2\%$), suggesting that structured facilitation of family literacy practices yields significant returns even in communities with comparatively higher baseline educational capital.

Paired-sample t-test results confirmed the statistical significance of all pre-post differences at $p < .001$, with 95% confidence intervals excluding zero across all six indicators, affirming that the observed improvements cannot be attributed to maturation effects, regression to the mean, or measurement artifact. These findings are consistent with the broader empirical literature on community-based literacy

interventions in indigenous Pacific contexts. Cunningham and Stanovich (1997) demonstrated through their work on the "Matthew Effect" in reading development that early literacy gains generate compounding developmental returns, creating virtuous cycles in which successful early readers access richer linguistic input and build vocabulary and comprehension at accelerating rates. The program's documented effect sizes suggest that it has successfully catalyzed such positive developmental cycles for a substantial proportion of participating children, with facilitated midpoint assessments indicating that the trajectory of improvement accelerated between Months 6 and 12 relative to the initial intervention phase, consistent with the theoretical prediction of threshold effects in bilingual literacy acquisition documented by Cummins (2001).

Cultural Mechanisms Mediating Literacy Empowerment

Qualitative analysis of 36 focus group discussions, 18 individual narrative interviews, and 240 structured ethnographic observations identified five primary cultural mechanisms through which the program's community-based design mediated and amplified literacy learning beyond what technical instruction alone could achieve. The first and most pervasive mechanism was the integration of oral narrative traditions as pedagogical scaffolding for written literacy acquisition. Across all three provincial clusters, facilitators, elders, and caregivers consistently described the use of traditional oral genres—including creation myths, genealogical narratives, agricultural knowledge stories, and ceremonial songs—as transformative bridges between children's prior cultural knowledge and the abstract symbolic systems of written language. As one Enga elder advisor reflected in a focus group discussion: "When the children hear the stories of the land in writing, they understand that writing speaks with a voice they already know. The paper becomes alive." This finding resonates with Barton and Hamilton's (1998) foundational theory of literacy as social practice, which holds that literacy learning is most deeply sustained when it is anchored in the meaningful communicative practices that organize community life rather than treated as an isolated technical competency.

The second identified mechanism was the activation of what the research team conceptualized as intergenerational epistemic authority, wherein the deliberate positioning of community elders as co-facilitators and knowledge validators within instructional settings restructured the social relations of learning in ways that enhanced both children's motivation and the cultural legitimacy of the literacy program within the broader community. Chilisa (2019) argued that indigenous research and educational frameworks must operationalize relational accountability as a structural principle rather than an aspirational value, meaning that the relationships between generations, between communities and knowledge systems, and between practitioners and the natural world must be actively honored within educational processes (Muhsyanur, 2025). The present program enacted this principle through the Elder Storytelling Integration Protocol, a structured facilitation framework in which elder community members conducted monthly oral narrative

sessions with child learner cohorts, with the research team subsequently supporting children in co-authoring written versions of elder-narrated stories, creating bilingual texts that served simultaneously as literacy resources and as vehicles for cultural heritage preservation.

The third mechanism, caregiver literacy partnership, addressed what UNESCO (2020) identified as one of the most consistently underutilized resources in indigenous literacy development: the transformative potential of informed, empowered, and pedagogically supported family engagement in children's literacy learning. The program implemented a structured Family Literacy Workshop series, comprising eight monthly sessions at each provincial site, which equipped caregivers with specific, culturally contextualized strategies for supporting home literacy practices, including the creation of oral story-telling routines, the use of environmental print (community notices, food packaging, church signage) as reading material, and techniques for engaging children in reflective discussions about the indigenous-authored storybooks distributed through the program. Caregiver participation rates across the three sites averaged 73%, substantially exceeding the 40–55% benchmarks reported in comparable family literacy programs in Melanesian contexts documented by the Pacific Community's Education Quality and Assessment Programme (EQAP, 2019) (Ramadhanti et al., 2021). Critically, the ethnographic observational data documented a strong positive association between caregiver engagement intensity and the depth of children's post-session literacy practice in home environments, consistent with findings reported by Britto and Brooks-Gunn (2001) concerning the disproportionate influence of family literacy environments on early reading development.

The fourth and fifth mechanisms—vernacular language affirmation and physical environment restructuring—operated at the level of what Cummins (2001) termed "identity investment," the degree to which learners perceive the language and knowledge of their heritage community as valued, valid, and visible within educational settings. The program's explicit use of home language instruction during the initial literacy phase, its commissioning of vernacular-language storybooks authored and illustrated by community members, and its display of highland cultural artifacts within literacy learning spaces collectively created what the ethnographic data described as "classrooms that belong to us"—learning environments experienced by children, caregivers, and facilitators as culturally affirming rather than culturally extractive. Hornberger and Link (2012) emphasized that translanguaging pedagogies are not merely instructional techniques but acts of educational justice that reconstitute the power relations embedded in literacy instruction by validating the full linguistic repertoire of learners. The program's documentation of these mechanisms offers a grounded, context-specific illustration of how translanguaging principles can be operationalized in remote Melanesian highland settings with limited material resources but rich cultural and community assets.

Community Ownership and Sustainability Dynamics

A central concern in the design of community-based literacy interventions is the degree to which observed gains can be sustained beyond the formal program cycle without continued intensive external support. The evaluative documentation phase of the present study generated substantial evidence that the program's community ownership architecture—comprising the Village Literacy Facilitator system, the Elder Advisory Councils, the Community Storybook Library Network, and the Caregiver Literacy Partnership infrastructure—had generated durable organizational and social capital capable of sustaining literacy activities beyond the funded intervention period. Exit ethnographic observations conducted in Months 11 and 12 documented that 21 of 24 community clusters had independently continued weekly literacy sessions following the formal withdrawal of the research team's facilitation support in Month 10, with VLFs transitioning from supported implementers to autonomous community literacy leaders and, in several instances, training additional community members in basic literacy facilitation techniques.

The concept of community ownership in educational development has been theorized as a dynamic and contested construct whose realization requires deliberate attention to power-sharing mechanisms, resource stewardship, and the scaffolded transfer of decision-making authority from external program designers to community stakeholders across the program lifecycle. Lave and Wenger (1991), in their influential theorization of communities of practice, identified legitimate peripheral participation as the mechanism through which newcomers progressively develop competence, identity, and agency within a community's shared practice—a process that the present program deliberately enacted by positioning VLFs, caregivers, and elder advisors as progressively more central actors in the design, delivery, and evaluation of literacy activities as the program advanced. Qualitative data from facilitator narrative interviews consistently reflected this developmental trajectory, with VLFs in Month 12 describing their roles not as program employees but as community literacy stewards whose responsibilities extended beyond the program to encompass the broader educational wellbeing of their communities.

The Community Storybook Library Network, established in the program's fourth month through a participatory co-design process involving children, caregivers, and elder advisors, emerged in the evaluative phase as a particularly robust sustainability mechanism. By the program's conclusion, the network comprised 24 community storybook libraries—one per cluster—housing an average of 38 bilingual illustrated titles, including the 14 Kuman-language texts co-produced in Simbu Province and equivalent vernacular-language productions from Enga and Western Highlands. Library usage data collected through a simple tally register system maintained by VLFs indicated that 89% of enrolled children had borrowed library materials at least once during the final program quarter, with a mean borrowing frequency of 2.7 texts per child per month. These usage patterns represent a significant departure from the near-total absence of indigenous-language print material in these communities prior to program implementation, and they

substantiate the argument advanced by Neuman and Celano (2001) that the creation of accessible, culturally relevant print environments constitutes one of the highest-leverage structural interventions available for promoting equity in early literacy development in resource-constrained communities.

The challenges encountered in sustaining community ownership illuminate important design considerations for future iterations of the program and for analogous initiatives in comparable contexts. In three community clusters—two in Enga Province and one in Western Highlands Province—community ownership of literacy activities weakened significantly following the departure of the research team's facilitation support, with exit ethnographic data attributing this deterioration to the departure of key VLFs to urban employment and the absence of sufficient locally available material resources to support ongoing program activities. These findings underscore the warnings articulated by Bringle and Hatcher (1996) against community service models that generate participant dependency on external human capital rather than building indigenous institutional capacity to resource and govern programs autonomously. Future program iterations should prioritize the establishment of community governance structures with clear succession planning mechanisms for VLF roles, diversified resource procurement pathways that reduce dependence on externally supplied materials, and formal institutional linkages with provincial education departments and local government units capable of providing ongoing technical and financial support to community literacy initiatives. The principle of sustainability-by-design demands that program architects attend as carefully to the conditions of a program's conclusion and transition as to the conditions of its initiation and delivery.

CONCLUSION

This study demonstrates that a community-based, culturally responsive literacy empowerment program can achieve substantial, statistically significant, and educationally meaningful improvements in foundational literacy outcomes among indigenous children in the remote highlands of Papua New Guinea, while simultaneously building the community agency, organizational infrastructure, and cultural affirmation necessary to sustain literacy development beyond the formal program lifecycle. With a mean effect size of Cohen's $d = 0.90$ across six literacy indicators and documented evidence of autonomous community continuation in 87.5% of participating clusters, the program provides robust evidence that culturally embedded, elder-guided, caregiver-partnered, and vernacular-language-affirming approaches to literacy instruction are not merely theoretically sound but practically effective under the complex real-world conditions of geographic remoteness, resource scarcity, and sociolinguistic diversity that characterize the PNG highland context. To extend the program's reach and deepen its impact, the following recommendations are offered: (1) Provincial and national education authorities should formalize and fund the Village Literacy Facilitator model as a recognized community paraprofessional role within the PNG elementary education system; (2)

the Community Storybook Library Network should be expanded and institutionalized with provincial government co-financing to ensure ongoing vernacular-language material production; (3) teacher training institutions in PNG should integrate culturally responsive bilingual literacy pedagogy and community partnership frameworks into pre-service and in-service teacher education programs; (4) analogous programs should be designed and piloted in comparable Pacific island contexts—including Solomon Islands, Vanuatu, and Timor-Leste—to generate a Pacific-specific evidence base for indigenous community literacy empowerment; and (5) funding agencies and development partners should adopt long-term (minimum five-year) program horizons and invest in participatory monitoring and evaluation systems that center community-defined measures of literacy and educational wellbeing alongside conventional academic assessment metrics.

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