

Maternal Malnutrition and Its Associated Adverse Pregnancy Outcomes and Childbirth in Dadu District, Sindh, Pakistan



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Abstract

Background: Maternal malnutrition poses serious risks to both mother and child, contributing to adverse pregnancy outcomes such as anemia, pre-eclampsia, and low birth weight. Addressing maternal malnutrition is essential for promoting healthy pregnancies and favorable birth outcomes.

Methodology: The study involved 660 third-trimester pregnant women at a tertiary care hospital in Dadu district, Sindh, Pakistan. The aim was to identify the association patterns of maternal nutrition on birth outcomes to inform future programming. Data were collected using a mixed-methods approach with a snowballing technique. Bivariate and multivariate analyses were performed using R-Studio and Canvas software to analyze associations and differences related to maternal nutrition.

Results: The majority of rural participants (84%) intended to deliver at DHQ Dadu, with 81% facing inconsistent family income sources, impacting food security and healthcare access. Maternal education positively correlated with healthcare service utilization, while maternal counseling had a weaker influence. Early pregnancies were prevalent, with 29% of women reporting their first pregnancy before age 20 and 6.7% before age 16. Iron and folic acid utilization was suboptimal (20.4%), and access to healthcare was hindered by distance, cost, and inconsistent coverage, particularly in rural areas. Maternal malnutrition was a significant concern, with 15.4% identified as acutely malnourished.

Conclusion: The study highlights significant challenges, including socioeconomic disparities, early pregnancies, inadequate healthcare access, and poor maternal nutrition status. Targeted interventions such as improving healthcare infrastructure, enhancing maternal education, promoting early prenatal care, strengthening community-based nutrition programs, and leveraging social safety net programs can help mitigate adverse birth outcomes.

Keywords: Maternal malnutrition; childbirth; ANC visits; adverse pregnancy outcomes; low birth weight

How to cite this article: Fazal S, Shahid Y, Nadhman A, Amjad N, Naeem M, Khan S, et al. Maternal Malnutrition and Its Associated Adverse Pregnancy Outcomes and Childbirth in Dadu District, Sindh, Pakistan. Pak J Public Health 2024 Aug. 5; 14(Special.NI):127-33.
Available from: <https://pjph.org/pjph/article/view/1374> DOI: <https://doi.org/10.32413/pjph.v14iSpecial.NI.1374>

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Submitted: 15-02-2024

Revised: 01-04-2024

Accepted: 17-04-2024

Published: 05-08-2024

Introduction

Adequate nutrition during pregnancy is essential for ensuring the health of both the mother and the newborn infant (1). In Pakistan, as in many other countries, poor maternal nutrition can lead to various adverse outcomes, including pre-eclampsia, anemia, hemorrhage, and even maternal and infant mortality (2). Moreover, maternal malnutrition can directly affect the development and well-being of the newborn (1). The literature highlights a direct correlation between maternal and infant malnutrition, emphasizing the importance of addressing maternal nutritional needs during pregnancy and childbirth (3). To promote a healthy pregnancy, safe delivery, and optimal newborn development, addressing maternal malnutrition is imperative. Interventions such as counseling, behavior

modification programs, and nutritional support have been shown to improve maternal and child health outcomes (4). Prioritizing maternal nutrition during the critical "first thousand days," from conception to a child's second birthday, can significantly mitigate associated risks (1). In Pakistan, factors contributing to maternal malnutrition and adverse childbirth outcomes include food insecurity, poverty, inadequate maternal and parental education, and suboptimal healthcare practices (5). Addressing these underlying factors requires comprehensive and integrated interventions. Pakistan faces a triple burden of malnutrition, with women and children disproportionately affected. Nationally, a significant percentage of children under five are stunted or wasted, while a considerable portion of women of reproductive age are underweight, overweight, or anemic (6). These nutritional challenges are

compounded by household food insecurity, inadequate hygiene and sanitation measures, poverty, gender inequality, and low levels of education (6). The 2018 National Nutrition Survey (NNS) reported high levels of malnutrition consistent with elevated rates of infant and maternal mortality (6). Dadu district, like many other regions in Pakistan, grapples with a high prevalence of maternal malnutrition, often exacerbated by poverty and limited access to healthcare. This study aims to investigate the relationship between maternal malnutrition and its impact on pregnancy, labor, and neonatal outcomes. By identifying key risk factors, assessing health outcomes, and recommending potential interventions related to maternal nutrition, this research seeks to contribute to efforts aimed at improving maternal and child health in Dadu district and similar contexts.

Methodology

Study Design: This study was conducted at a tertiary care hospital, specifically the Civil Hospital in District Dadu, Sindh, Pakistan. The study focused on tracing pregnant women from Basic Health Units (BHUs) with the coordination of Lady Health Workers (LHWs), the Maternal, Neonatal & Child Health Program (MNCH program), and the People's Primary Healthcare Initiative (PPHI). Enrolment targeted pregnant women in their third trimester to monitor pregnancy progression, birth outcomes, and neonatal health.

Sample Size: The sample size determination involved multiple steps. Initially, ENA software was utilized, followed by a review of secondary data from hospital monthly reports and expected delivery databases. With a confidence interval of 95% and a margin of error of 4%, a sample size of 529 was calculated based on the population of Dadu. However, to mitigate potential risks such as untraceable population, non-delivery during the study period, and dropouts, the sample size was increased to 712. Ultimately, 660 samples were attained, with 52 excluded due to non-delivery or intractability.

Study Duration: Data collection occurred from September 25th to December 25th, 2023, employing a mixed methodology with a snowballing approach. This iterative process continued until data saturation was achieved, and any gaps were addressed through additional probing.

Data Analysis: Data collected from participants were entered into an Excel database and analyzed using R-studio (version 4.3.2) and Epi info software. Continuous variables were assessed for normality, and categorical data were presented as frequencies and proportions. Multivariate correlation analyses were conducted to explore relationships between maternal and neonatal outcomes and various maternal factors. Statistical tests, including chi-square, T-test, and ANOVA, were employed to examine associations and differences between variables. Figures

were generated using R-studio and Canvas software.

Results

The study sample predominantly consisted of individuals from rural settings, with 84% of patients belonging to such areas and expressing their intent to deliver at DHQ Dadu. Furthermore, 81% of the recruited families reported inconsistent sources of income, posing challenges to food security and healthcare access. While maternal education exhibited a positive association with healthcare service utilization, the influence of maternal counseling was found to be weak. Notably, 15% of families had no literate members, while others had members educated up to at least the minimum middle school level.

A considerable proportion of women reported early pregnancies, with 29% experiencing their first pregnancy before their 20th birthday and 6.7% are pregnant before the age of 16 years. Figure-1 provides visual representation regarding the ages at which females experienced their first pregnancies.

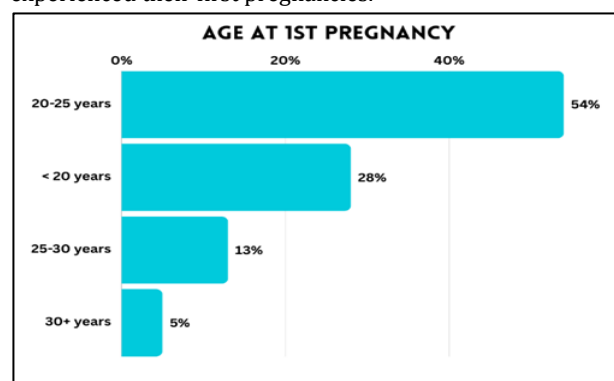


Figure 1. Age Distribution of First Pregnancies among Females

Health problems during pregnancy were reported being high blood pressure, gestational diabetes, infections, preeclampsia, preterm labor, depression, anxiety, pregnancy loss, and stillbirth. Recognizing danger signs during pregnancy is crucial for timely medical intervention. Common danger signs experienced by mothers included severe abdominal pain (36.2%), swelling (14%), fatigue (9.2%), reduced fetal movement (7.4%) and vaginal bleeding (3.6%).

Iron and folic acid supplementation during pregnancy is essential for preventing anemia and supporting fetal development. While 79.6% of women received iron-folic acid (IFA) supplements during their last pregnancy, only 20.4% complied with the recommended intake. Reasons for non-utilization included domestic duties, perceived ineffectiveness, and side effects like constipation and nausea.

The qualitative assessment revealed several critical challenges within Maternal, Neonatal, and Child Health (MNCH) services. Inconsistent recording of baseline

Body Mass Index (BMI) and inadequate weight tracking were observed, reflecting gaps in standard procedures across healthcare levels. While Lady Health Workers (LHWs) played a vital role, their patchy coverage limited their access to essential services, impacting ANC visits and pregnancy outcomes. Heavy workloads restricted LHW visits during pregnancy, exacerbated by engagement in national immunization campaigns, created accessibility barriers. Inadequate forecasting by LHWs resulted in supplement stockouts at health facilities, affected the continuity of care. The availability of unique maternal IDs presents an opportunity to develop an MNCH app pilot project for improved data integration and service coordination.

It was evident by the analysis that midwives commonly handled the complicated pregnancies, while gynecologists tend to prioritize cesarean deliveries due to the low patient-doctor ratio. Given this constraint, it's impractical for all complicated pregnancies to be managed solely by gynecologists. Figure 2. Illustrates the ratio of distribution of healthcare providers attending complicated deliveries and caesarian sections.

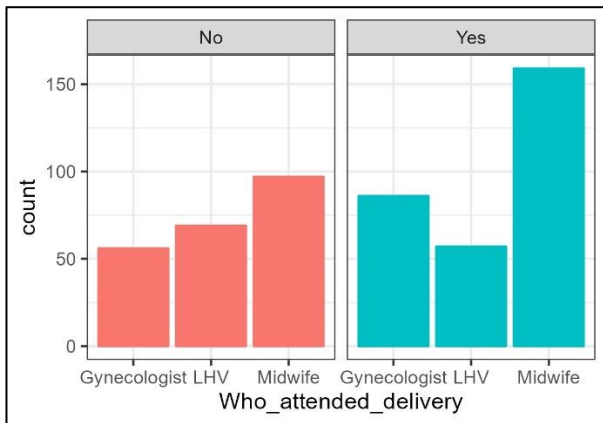


Figure 2. Distribution of Healthcare Providers Attending Complicated Deliveries (Statistically Significant, $p < 0.05$)

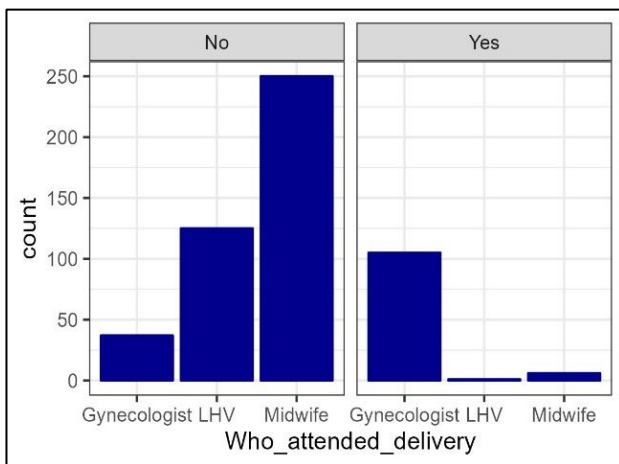


Figure 3. Distribution of Healthcare Providers Performing Caesarian Sections (Statistically Significant, $p < 0.05$)

Access to healthcare facilities was hindered primarily by distance, with the cost of travel identified as the most significant barrier (46%), followed by waiting time and perceived quality of care, each cited by approximately 20% of respondents. In remote areas, where communities are farther from health facilities, these challenges were exacerbated, leading to fewer ANC visits. Our study found a strong association between ANC visits and both the distance from health facilities and the occurrence of complicated pregnancies ($p < 0.01$). Specifically, for every increase in distance, there was a corresponding decrease in ANC visits and an increase in the likelihood of complicated pregnancies. Furthermore, the concentration of health services around health facilities resulted in patchy coverage in surrounding communities, with fewer Lady Health Worker (LHW) home visits in areas farther from health facilities ($p < 0.0001$). These disparities highlight the urgent need for extended outreach efforts to ensure equitable access to healthcare services, particularly in remote communities where the burden of maternal complications and adverse pregnancy outcomes is disproportionately higher.

In our study, MUAC measurement revealed that 15.4% of enrolled mothers in district Dadu were identified as acutely malnourished based on a cutoff of < 21.0 cm. This finding suggests a notable risk of malnutrition among this population, with potential adverse effects on delivery outcomes. Indeed, there was a significant association ($p < 0.01$) between maternal malnutrition, as indicated by MUAC < 21.0 cm, and low birth weight (LBW) neonates, with 41.3% of live births among malnourished mothers (MUAC < 21.0 cm) resulting in LBW babies (< 2.5 kg). The same pattern persists among malnourished mothers who have experienced danger signs such a cessation or reduction in the baby's movement, severe belly pain, overwhelming tiredness in the pregnancy stage as compared to mother with a normal MUAC ≥ 21.0 cm.

Interestingly, even among mothers who were not malnourished as per the above cut off points, there was a concerning rate of LBW deliveries, with a quarter of live births falling into this category. Figure 4. displays the correlation between malnutrition and with an outcome of Low Birth Weight (LBW).

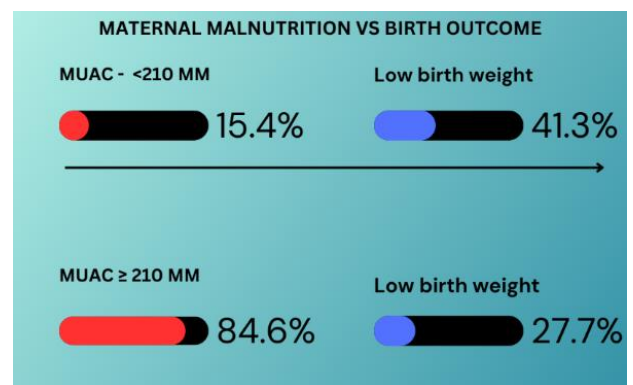


Figure 4. Maternal malnutrition correlation with an outcome of Low Birth Weight (LBW)

The Minimum Diet Diversity for Women (MDD-W) serves as a crucial indicator of dietary adequacy among women aged 15-49, determined by whether they consumed at least five out of ten specified food groups on the preceding day or night are more likely to have higher micronutrient intakes than groups of women who do not, and the proportion of women with low MDD-W scores are more likely to experience malnutrition, and poor birth outcomes. The current study meticulously documented the dietary habits of all participants, revealing significant associations between MDD-W scores and birth outcomes.

Mothers who attended more than four ANC visits demonstrated better MDD-W scores ($p < 0.044$) compared to those with fewer visits ($p > 0.05$), indicating that adherence to ANC counseling improves dietary diversity despite prevailing economic challenges. This suggests that well-counseled mothers make better food choices, enhancing dietary diversity within their usual diets.

Furthermore, a strong positive correlation ($p < 0.01$) was observed between MDD-W and birth outcomes. The majority (71%) of respondents scored low on the dietary diversity indicator, with this group exhibiting the highest prevalence of low-birth-weight neonates (37.7%). In contrast, only 11% of women fell into the high MDD-W category, characterized by a wide variety of food groups in their diet, likely contributing to a balanced and nutrient-rich dietary pattern. Figure 4. displays the correlation between MDD-W and low birth weight in pregnant women.

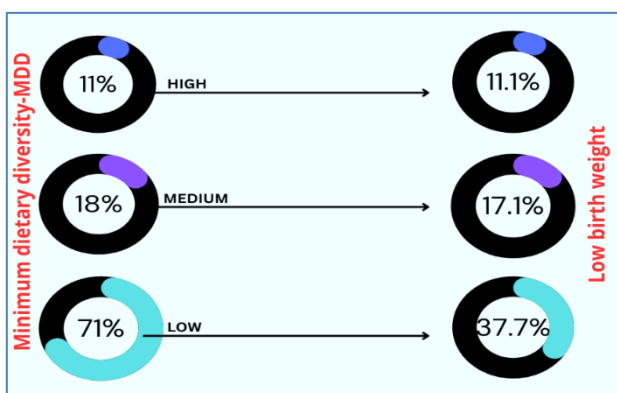


Figure 5. Correlation between Minimum dietary diversity in pregnant women (MDD-W) with an outcome of Low Birth Weight (LBW)

Discussion

The findings of this study shed light on various challenges and opportunities in maternal and child healthcare (MNCH) in Dadu district, Pakistan. Nutrition status of pregnant women is a powerful predictor of birth outcomes. Based on records from hundreds of thousands of children, a number of studies have found strong links between maternal nutrition status and child mortality (18). Early marriage increases the risk of adolescent pregnancy, which has an

acute effect on the health and well-being of young women, bringing with it nutritional risks, higher risks of poor pregnancy and low birth weight outcomes (7,15). Pakistan ranks sixth globally in terms of the number of girls married before the age of 18 (16) and the study revealed that a significant majority of females had their first child in adolescence. The primary determinant of nutritional status is linked to the first pregnancy, since women who are middle-aged but had their first child in adolescence have poor birth outcomes compared to those women who conceive after the age of 20, posing an irreversible loss. Early and regular prenatal care is essential for reducing the risk of pregnancy complications. The analysis of ANC visits revealed a varied pattern among pregnant mothers, with a significant proportion failing to meet the recommended ANC thresholds. However, attending ≥ 4 ANC visits was associated with improved birth outcomes (13), underscoring the importance of comprehensive prenatal care. A closer examination of the data revealed that attending ≥ 4 ANC visits was associated with improved birth outcomes, with significant reductions in the occurrence of complications such as ectopic pregnancies, anemia, hypertension, cesarean deliveries, and neonatal mortality. The data demonstrated a strong negative correlation between ANC visits and complicated pregnancies. Furthermore, ANC attendance showed a significant association with a reduced incidence of anemia, hypertension, and cesarean sections.

Counseling, particularly by Lady Health Workers (LHWs), demonstrated significant associations with family planning utilization and the management of complicated pregnancies (13,14), highlighting the crucial role of counseling services in maternal healthcare. The study observed a significant association between Lady Health Worker (LHW) visits, particularly in LHW-covered areas, and family planning (FP) utilization ($p < 0.00001$), indicating the positive impact of LHW counseling on FP compliance. Counseling demonstrated notable significance in managing complicated pregnancies ($p < 0.01$), underscoring its pivotal role in maternal healthcare. Comparing the effects of nutrition counseling versus FP counseling revealed a significant difference ($p < 0.001$), suggesting the need for further assessment of each counseling type's efficacy in achieving targeted outcomes. Similarly, there was a significant correlation between FP counseling and actual FP usage ($p < 0.001$), highlighting the effectiveness of counseling services in influencing family planning decisions.

The findings regarding iron and folic acid (IFA) supplementation underscore both successes and challenges in maternal healthcare provision. While a commendable coverage rate was achieved, the alarmingly low compliance rate highlights a concerning gap between accessibility and actual utilization of essential supplements. Moreover, the insignificant association between IFA compliance and

education status suggests that educational interventions alone may not suffice to address barriers to supplementation. Commonly reported reasons for non-utilization, including concerns about side effects and misconceptions about effectiveness, call for targeted community-based interventions to address underlying beliefs and promote optimal utilization. These findings emphasize the importance of holistic approaches that not only ensure access to supplements but also provide education, support, and resources to overcome barriers and enhance compliance. Such interventions are crucial for improving maternal and fetal health outcomes and require collaborative efforts between healthcare providers, policymakers, and communities to implement effective strategies and mitigate the risks associated with inadequate supplementation during pregnancy. The critical analysis of access to health facilities reveals multifaceted challenges that disproportionately affect communities living in distant areas. While distance emerges as a primary barrier, compounded by the financial burden of travel costs, waiting times, and perceived quality of care further exacerbate the issue. These challenges are particularly pronounced for communities in remote regions, where access to essential health services is limited. The necessity of male accompaniment or cost-sharing arrangements within these communities adds another layer of complexity, hindering access for vulnerable populations. The correlation between ANC visits and both distance from health facilities and the occurrence of complicated pregnancies underscores the urgent need for equitable distribution of healthcare services. The concentration of services around health facilities, evidenced by patchy coverage and fewer Lady Health Worker (LHW) home visits in distant communities, highlights systemic disparities. Addressing these challenges requires comprehensive strategies to extend outreach efforts and ensure equitable access to essential maternal healthcare services, ultimately mitigating the risks associated with inadequate prenatal care and promoting positive pregnancy outcomes. The predominance of rural participants and the prevalence of inconsistent income sources highlight the socioeconomic challenges faced by communities in Dadu district. Such challenges exacerbate food insecurity and hinder access to healthcare services (7), as evidenced by the significant association between distance from health facilities and ANC visits. The high prevalence of maternal malnutrition, as indicated by MUAC measurements, poses a significant risk to pregnancy outcomes. There is a notable association between maternal malnutrition and low birth weight (LBW) neonates (8,9,10), highlighting the importance of addressing nutritional deficiencies during pregnancy. Poor adolescent and maternal nutrition prior to, and during, pregnancy can lead to increased risk of maternal anaemia, pre-term birth and low infant birth weight. High rates of micronutrient

deficiencies among women of reproductive age perpetuate a vicious cycle of malnutrition, contributing to a high burden of morbidity and mortality among women and children while manifesting increased risks of non-communicable diseases prevalence in future generations (22,23). Women in Pakistan are particularly susceptible to malnutrition because of cultural norms that result in their food intake being lesser than that of the rest of the family (22). Moreover, in Pakistan, women face intra-household discrimination with regards to the distribution of resources (24). This discrimination results in compromised nutritional outcomes. There are multiple effects of these nutritional discrepancies on the outcomes on women as well as children. Malnutrition starts from birth and continues through early life and can have adverse long-term effects. The Minimum Diet Diversity for Women (MDD-W) serves as a crucial indicator of dietary adequacy (11), with higher MDD-W scores associated with improved birth outcomes while the contrast contributes to low birth weight. Promoting dietary diversity among women is essential for addressing nutritional deficiencies and supporting maternal and child health (19). Poor nutrition status in pregnancy is also associated with about one third of child mortality in Pakistan and mother's breastfeeding behavior is associated with one-fifth of child mortality cases (2,4,6). If the mother's breastfeeding behavior is considered, which accounts for an estimated 21 percent of projected mortality, maternal factors may account for more than half of all deaths. Therefore, simply focusing on providing nutrition services to children, and not mothers, may miss half the mortality threat. Nonetheless, The Benazir Income Support Program (BISP) plays a critical role in supporting economically disadvantaged individuals, particularly pregnant and breastfeeding women (12). Social protection aims to facilitate marginalized and vulnerable segments through public interventions and collective efforts to improve their standard of living and resilience against risks and vulnerabilities (20). The study found a significant association between BISP support and improved birth outcomes, emphasizing the importance of social safety nets (SSNs) in mitigating adverse pregnancy outcomes among vulnerable populations. The aim protects poor and impoverished segments by managing uncertain risks, building their resilience and making societies more equitable. The success rate of SSNs in various countries depends on many factors, including targeting, coverage, enrollment of the beneficiaries and adequacy of the financial assistance (21).

Conclusion

This study underscores the critical importance of addressing maternal and child healthcare challenges in Dadu district, Pakistan, to improve health outcomes and promote sustainable development. The findings highlight the

complex interplay of factors influencing maternal and child malnutrition, including socioeconomic disparities, limited access to healthcare facilities, and cultural norms. Despite commendable efforts in maternal healthcare provision, gaps persist in ensuring equitable access to essential services and promoting optimal utilization of interventions such as iron and folic acid supplementation. However, actionable recommendations emerge from the analysis, including the implementation of targeted community-based interventions, investments in healthcare infrastructure, and multi-sectoral collaborations to address the root causes of maternal and child malnutrition. By prioritizing maternal and child health on national agendas and fostering partnerships between government agencies, non-profit organizations, and community stakeholders, we can work towards achieving the Sustainable Development Goals and ensuring the well-being of future generations in Dadu district and beyond.

Acknowledgments

The authors gratefully acknowledge funding by the Save the Children International, Contract No. Con-Consultancy-Pak-Isb-2023-009.

Ethical Approval:

The study did not require any ERC/IRB approvals because it was an operational study with no intervention designs, neither were any biochemical assessments done. The study was based on history from the respondents and health care providers.

Financial support and sponsorship: None declared.

Conflict of interest: None declared.

Authors' Contribution:

SF: Designed and led the whole project including write-up, reviewing and finalizing the article.

YS and MN: Arranged the access to project area beneficiaries and health facilities and reviewed the initial and final draft.

MA: Developed the methodology and managed the field work and the initial data analysis.

AN: Did the statistical analysis and initial write-up.

SK, AK, and NS: Helped in the data collection, field work and coordination.

NA: Finalized the article and gave it the final touches.

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