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Impact of family and community medicine residency on performance indicators

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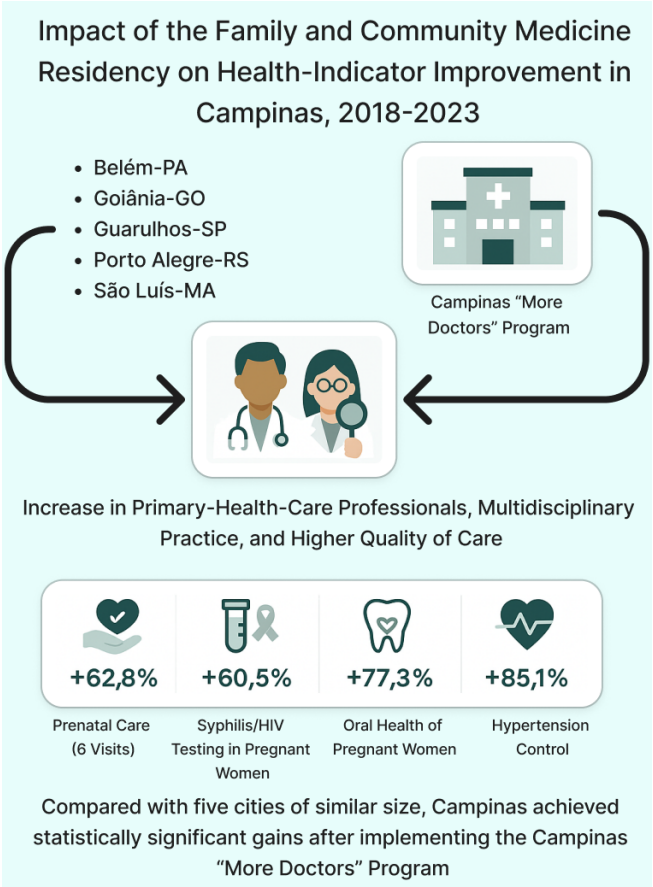
Highlights

- *The Family and Community Medicine (FCM) Residency Program improved health indicators in Campinas.*
- *Follow-up of hypertensive patients in Primary Health Care increased by 85.1% after the intervention.*
- *Prenatal care with six or more visits increased by 62.8% after implementation.*
- *Syphilis/HIV testing in pregnant women rose by over 60%.*
- *Dental follow-up for pregnant women improved by 77.3%.*
- *Comparison with five Brazilian cities showed statistically significant gains.*
- *The strategy strengthened interdisciplinary practices and quality of care*
- *Investments in FCM lead to concrete improvements in quality of care.*

Graphical Abstract



Abstract

This study aimed to evaluate the impact of implementing the Family and Community Medicine Residency Program on health indicators in Campinas, comparing the results with those of other Brazilian cities. The study employed an observational and descriptive design, analyzing secondary data obtained from the Primary Health Care Information System for the years 2018 to 2023. The analysis was conducted using Student's t-test and the Difference-in-Differences (DiD) methodology. The results showed significant improvements in the mentioned indicators, with increases ranging from 3.61% to 85.09% in health indicators in Campinas, while the other cities did not show such substantial variations. These findings indicate a positive impact of the residency program on Primary Health Care, suggesting that the presence of family and community physicians contributed to improving the quality of and access to health services in Campinas. It is concluded that the continuation and expansion of the program are recommended, as well as the continuous monitoring of health indicators to ensure the sustainability of the achieved results.

Keywords: Primary Care. Indicators. Evaluation. Residency. Performance.

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INTRODUCTION

The restructuring of Primary Health Care (PHC) has become a central priority in global health policies, recognized as a key component in achieving the quadruple aim: improving the quality of care, enhancing health outcomes, providing better experiences for health professionals, and optimizing the value of the investments made[1].

The historical evolution of PHC reflects a significant shift from a model focused solely on diagnosing and treating diseases to a comprehensive approach aimed at supporting the population's health and well-being. This transformation includes the efficient management of chronic conditions and the promotion of population health. The PHC reform movement, understood as the transition from a narrow "primary care" approach to the broader concept of "primary health care," gained global prominence with pioneering initiatives such as those implemented in Canada. A milestone in this trajectory was the creation of the Primary Health Care Transition Fund in 2000, which encouraged Canadian provinces to reform and redesign their PHC systems. The main objectives of this initiative included expanding access to care, promoting health, providing essential services, and consolidating interdisciplinary health teams[2]. Since then, these initiatives have been replicated and adapted in various contexts worldwide, always focusing on integrating health and social services to more effectively and equitably address the social determinants of health[3].

In Brazil, the Family Health Strategy (FHS), established in 1994, was implemented as part of a broader strategy to reorganize the Unified Health System (SUS). The goal was to transform the health care model, which had previously been centered on hospitals and specialized care, into a more comprehensive model closer to the communities[4]. The FHS was initially implemented in small and medium-sized municipalities, quickly demonstrating its potential to improve access to basic health services and promote equity in health care[5]. However, one of the main challenges faced by the FHS since its implementation has been the unequal distribution of family health teams, especially in large cities and metropolitan regions[6,7]. Nevertheless, the FHS has shown significant potential, promoting a comprehensive and continuous approach, humanizing care, and strengthening the bond between health professionals and users[8,9].

In 2019, the Brazilian Ministry of Health launched the *Previne Brasil* program with the aim of strengthening PHC in the country by restructuring the funding model for Basic Health Units (BHS). This program bases resource allocation on weighted capitation, pay-for-performance, and incentives for strategic actions, in accordance with the recommendations of Ordinance No. 2,979, dated November 12, 2019. Under the pay-for-performance scheme, the following indicators are monitored: prenatal care coverage, the proportion of pregnant women with at least six prenatal visits, with the first visit occurring by the 12th week of pregnancy; pregnant women tested for syphilis and HIV; pregnant women who received dental care; women aged 25 to 64 who underwent cervical cancer screening in PHC; one-year-old children vaccinated in PHC against diphtheria, tetanus, pertussis, hepatitis B, infections caused by *Haemophilus influenzae* type b, and inactivated poliomyelitis; individuals with hypertension who had a consultation and blood pressure measurement in the semester; and individuals with diabetes who had a consultation and a glycated hemoglobin test ordered during the semester[10].

In the municipality of Campinas, the *Programa Mais Médicos Campineiro* (PMMC) was established in 2019 as a strategy to address the persistent underutilization of residency training positions in Family and Community Medicine (FCM). The PMMC represents a significant shift in the care model, promoting the replacement of focal specialists with the inclusion of Family and Community Physicians as the structuring axis of PHC. The PMMC was structured with an integrated approach to PHC, aiming to strengthen territorially based health care. Residents participate in 60-hour weekly schedules distributed among clinical care in Basic Health Units (BHS), community activities, and on-call support shifts. Each resident is supervised by an experienced preceptor, usually a family and community physician, with monthly meetings for case discussion and competency evaluation. Integration with multiprofessional teams involves collective meetings for care plan development and participation in thematic groups such as "Hiperdia" (hypertension and diabetes management) and community circles, ensuring a training process aligned with the needs of the local population. Among the program's main initiatives is the creation of a medical residency program in collaboration with local educational institutions, consolidating the integration between professional training and the strengthening of the health system. Preliminary results indicate a significant increase in the occupancy of medical residency positions and improved stability of the medical workforce in PHC, highlighting the positive impact of public policies aimed at training and retaining health professionals[10].

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This study aims to evaluate the impact of the *Programa Mais Médicos Campineiro* on the pay-for-performance health indicators in PHC in Campinas, as established by *Previne Brasil*. The analysis seeks to compare the results obtained before and after the implementation of the program, as well as with other municipalities that did not adopt similar initiatives, providing a comprehensive overview of the PMMC's effectiveness in restructuring and strengthening PHC in Campinas.

METHODOLOGY

This observational, descriptive study with a quantitative approach used aggregated public secondary data obtained from the *Primary Health Care Information System (SISAB)*, focusing on the indicators established by the *Previne Brasil* program. The analysis covered the years 2018 to 2023. To ensure the robustness of the results, statistical analysis included the use of descriptive statistics, such as relative frequencies and measures of central tendency, as well as semi-parametric modeling with a 95% confidence interval.

The *Previne Brasil* indicators analyzed in this study were selected based on their availability and relevance in assessing PHC performance, reflecting both the quality of care and access to primary health services. Among the indicators examined are prenatal care coverage, syphilis and HIV testing in pregnant women, dental follow-up for pregnant women, child vaccination coverage, cervical cancer screening (cytopathological exams), and follow-up of patients with hypertension and diabetes.

Campinas, located in the state of São Paulo and with an estimated population of 1.2 million inhabitants, was the main focus of this study. The city is notable for its high Human Development Index (HDI), as well as its role as a major technological and industrial hub in Brazil. It has an extensive Primary Health Care (PHC) network, consisting of 68 Basic Health Units (BHS), in addition to public health programs such as the *Programa Mais Médicos Campineiro*.

For comparative purposes, the cities of Belém, Guarulhos, Goiânia, São Luís, and Porto Alegre were included in the study. Despite their regional specificities, these locations share relevant common characteristics: populations ranging from 1 to 1.5 million inhabitants, structured PHC networks, and similar challenges related to access to health services. As prominent urban centers in their respective regions, they face difficulties associated with the efficient management of PHC, the reduction of socioeconomic inequalities, and the implementation of public health programs aimed at improving health indicators. These cities have developed urban infrastructures but struggle with issues such as overburdened health systems and the need for constant adaptation to the demands of their growing populations. These features make them suitable for comparison and analysis in the context of studies focused on strengthening PHC and evaluating public health policies.

The statistical analysis of the data was conducted using Student's t-test to compare the mean values of the indicators before and after the implementation of the PMMC in the city of Campinas. In addition, the Difference-in-Differences (DiD) methodology was employed to compare the changes in health indicators in Campinas with those observed in the other cities. This approach allowed for isolating the effect of the intervention by controlling for variables that could influence the results. All analyses were conducted using Python software, and the results were considered statistically significant for p-values < 0.05.

RESULTS

The data analyzed in this study were obtained from aggregated records of patients seen at Basic Health Units (BHS) in the cities of Campinas, Belém, Guarulhos, Goiânia, São Luís, and Porto Alegre during the years 2018 and 2023.

As shown in Table 1, the six cities have similarly sized populations (≈ 1.0–1.5 million inhabitants), but differ in population density, socioeconomic indicators, and age composition. The proportion of women ranges from 51.3% in Guarulhos to 54.0% in Porto Alegre, while the 20–49 age group accounts for between 46.8% (Porto Alegre) and 49.1% (Campinas) of residents11. The highest Human Development Index (HDI) scores are found in Campinas and Porto Alegre (HDI = 0.805), whereas Belém shows the lowest value (0.746)[11]. *Per capita* GDP further illustrates regional

economic disparities, ranging from R$ 22,216 in Belém to R$ 60,541 in Campinas[11]. Regarding education levels, Porto Alegre (25.8%) and Campinas (23.7%) have the highest proportion of adults with a completed higher education, compared to 11.4% in São Luís[11]. These contextual differences justify the municipality-level adjustment in the analytical model and should be considered when interpreting the observed effects.

Table 1 - Demographic and socioeconomic profile of the municipalities included in the study.

Municipality	Population*	Density* (inhab./km²)	Women* (%)	Ages 20-49 ** (%)	HDI**	Higher Ed. 25+** (%)	GDP*** (R$)
Belém	1,303,403	1,230.25	52.7	47.8	0.746	12.9	22,216.33
Campinas	1,139,047	1,433.54	52.3	49.1	0.805	23.7	60,541.04
Guarulhos	1,291,771	4,053.57	51.3	48.9	0.763	15.4	33,482.57
Goiânia	1,458,672	2,143.63	52.6	48.5	0.799	19.5	44,955.98
Porto Alegre	1,332,845	2,690.50	54.0	46.8	0.805	25.8	55,603.17
São Luís	1,037,775	1,779.87	53.4	48.2	0.768	11.4	32,739.65

Source: *2020 Census, IBGE. **Atlas Brasil 2010, IBGE. ***2021, IBGE.

After the implementation of the Family and Community Medicine (FCM) residency program, several health indicators in Campinas showed significant improvements, including: Prenatal Consultations (62.81%), Rapid Tests for Syphilis and HIV in Pregnant Women (60.54%), Dental Care for Pregnant Women (77.34%), and Hypertension Control (85.09%). For the indicators of Cervical Cytopathology Screening (32.85%), Vaccination (pentavalent + poliomyelitis – 3.64%), and Diabetes *Mellitus* Control (28.11%), increases were observed, though not statistically significant.

Following the implementation of the PMMC, prenatal consultation coverage in Campinas increased significantly, with a 62.81% rise (p = 0.0024). In comparison, the other cities analyzed did not show such marked changes, with average coverage remaining stable or increasing less expressively. The Difference-in-Differences (DiD) analysis confirmed that the increase in Campinas was statistically significant compared to the other cities, with a relative difference of 33.69% (p = 0.01364).

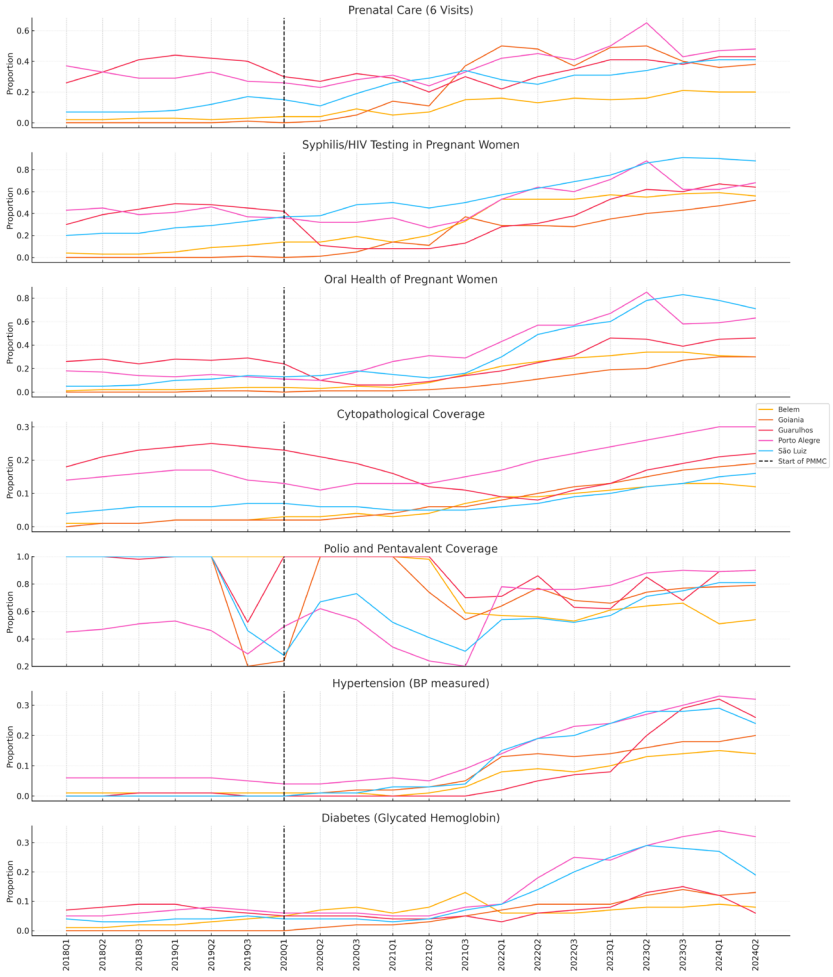
The rate of syphilis and HIV testing in pregnant women also showed significant improvements in Campinas, with an increase of 60.54% (p = 0.0421). The other cities recorded smaller increases, with Porto Alegre standing out as also showing a significant increase, albeit to a lesser extent than Campinas. The DiD analysis indicated that Campinas performed better than the other cities, with this increase attributed to the direct impact of the medical residency program implemented in the city, showing a relative difference of 40.76% (p = 0.07795).

Dental follow-up for pregnant women in Campinas increased by 77.34% (p = 0.0010), representing a statistically significant difference. In comparison, the other cities did not show substantial changes, with Guarulhos and São Luís even recording a slight decrease in coverage for this service. The DiD analysis revealed that Campinas was the only city with a substantial increase in this indicator, attributed to intensified efforts to promote oral health among pregnant women through the medical residency program, with a relative difference of 53.60% (p = 0.01068).

Although the increase in child vaccination coverage in Campinas was positive, with a 3.64% rise, it was not statistically significant (p = 0.4482). In comparison, Porto Alegre and Goiânia showed the highest vaccination coverage rates, surpassing Campinas. The DiD analysis did not show signifi-

cant differences between Campinas and the other cities, with a relative difference of -18.79% (p = 0.73721), suggesting that the implementation of the *Programa Mais Médicos Campineiro* had less impact on this specific indicator.

Cytopathological screening and the follow-up of patients with hypertension and diabetes in Campinas also showed improvements, although with smaller variations compared to other indicators. Cytopathological exam coverage increased by 32.85% (p = 0.1850), while hypertension follow-up rose by 85.09% (p = 0.0107) and diabetes follow-up by 28.11% (p = 0.4004). However, the DiD analysis indicated that these changes, although positive, were not significantly different from those observed in the other cities for cytopathological exams (p = 0.29634) and diabetes follow-up (p = 0.66705). In contrast, for hypertension, the relative difference was 76.15%, which was statistically significant (p = 0.04458).



Source: Primary Health Care Information System (SISAB).

Figure 1 - *Previne Brasil* indicators: temporal trends by indicator and city from 2018 to 2024.

DISCUSSION

The implementation of the PMMC demonstrated a positive impact on several health indicators in Campinas, particularly in prenatal consultation coverage, syphilis and HIV testing in pregnant women, dental follow-up for pregnant women, and the follow-up of patients with hypertension. These results suggest that the introduction of family and community physicians, promoted by the PMMC, significantly contributed to the quality of and access to PHC services. The improvement in maternal health care, evidenced by the increase in prenatal consultation coverage, reflects a strengthening of preventive and continuous care, in line with the program's core objectives. The early detection of infectious diseases through syphilis and HIV testing reinforces the importance of the PMMC intervention for maternal and child health. These findings are consistent with recent literature highlighting

the effectiveness of medical residency programs in PHC in enhancing maternal and child care[12,13,14].

The 62.81% increase in prenatal consultation coverage ($p = 0.0024$) is significant and reflects the direct impact of the PMMC on the reorganization of maternal and child care in Campinas. Recent studies indicate that expanding access to prenatal care is essential for reducing adverse outcomes such as maternal and neonatal mortality. According to *Previne Brasil* data[15], the national average for prenatal consultations carried out within the recommended criteria is below 50%, highlighting the importance of local interventions that prioritize PHC[16,17,18].

The rate of syphilis and HIV testing in pregnant women increased by 60.54% ($p = 0.0421$) in Campinas, a result that also exceeds the national average. The literature shows that early detection of these infections reduces maternal and perinatal complications and mitigates vertical transmission. Nationally, the coverage of these tests still shows significant variability, with averages below expectations in regions with limited access to structured PHC[15].

Dental follow-up for pregnant women in Campinas increased by 77.34% ($p = 0.0010$), with a statistically significant difference. In comparison, the other cities did not show substantial changes, with some even experiencing a slight reduction in coverage for this service. The DiD analysis revealed that Campinas was the only city with a significant increase in this indicator. This result reflects the importance of guidance and referrals provided by family and community physicians for oral health assessments, often carried out in collaboration with the dental care sector. In many cases, care for pregnant women was delivered jointly by residents and dentists, which helped overcome barriers such as patients' reported fear and ensured the opportunity for comprehensive dental evaluation during prenatal care[15].

In addition, hypertension control in Campinas registered a significant increase of 85.09% ($p = 0.0107$), with a relative difference of 76.15% compared to the other cities. This progress reflects the impact of a broadened and structured approach adopted by the residents in partnership with unit management. The organization and expansion of care through *Hiperdia* groups were accompanied by the implementation of innovative actions, such as shared consultations and collective outreach activities targeting patients who had discontinued follow-up. These patients were reached through initiatives conducted in the community, such as discussion circles in civil society organizations (CSOs), community kitchens, and smoking cessation groups.

Other activities were also implemented, including health promotion initiatives (group walks and other community engagement spaces), which fostered patient adherence to longitudinal follow-up and treatment. The creation of tailored groups, combined with intersectoral partnerships, strengthened the identification of undiagnosed hypertensive individuals in the community, ensuring more comprehensive care aligned with local needs. These data reflect the impact of the PMMC on chronic condition management. The presence of family and community physicians facilitates regular follow-up for hypertensive patients, which in turn reduces cardiovascular complications and improves quality of life. Studies conducted over the past five years support these findings, suggesting that physician training and presence in PHC significantly contribute to the effective management of chronic diseases[15,18,19].

Despite the technical training provided by the Family and Community Medicine residency, its isolated presence within Primary Health Care teams has not resulted in a significant increase in vaccination coverage. Studies from recent years show that improvement in this area depends more on structural and organizational factors, such as vaccine availability, proper functioning of the vaccination room, active search strategies, and addressing vaccine hesitancy[20,21]. Thus, although the FCM residency contributes to the technical and relational strengthening of PHC, vaccination coverage requires broader managerial and structural interventions, such as effective stock management, awareness campaigns, and specific training for vaccination settings.

Although the FCM residency promotes essential clinical competencies, its isolated presence has not been sufficient to improve cytopathological screening coverage in PHC. Recent studies indicate that factors such as limited time in medical schedules, lack of appropriate infrastructure and equipment, and the referral of this demand to specialists reduce the availability of the exam within PHC settings[22,23]. Thus, while FCM residents enhance technical competencies, improving access to cytopathological prevention requires structural interventions, organizational management, and institutional support, which are not automatically ensured by the existence of a residency program.

However, this study has some limitations that should be considered when interpreting the results. Firstly, the use of secondary and aggregated data may have limited the ability to conduct a detailed individual-level analysis, introducing potential bias-

es. Although the Difference-in-Differences strategy mitigates the impact of time-invariant unobserved factors, there remains the possibility of selection bias arising from intra-municipal socioeconomic variations, such as household income, education level, and access to health services, that could not be captured by aggregated records. We acknowledge that changes in the composition of the UBS user population over the evaluation period may have influenced the indicators, which could not be measured within the present ecological design. Sociodemographic and structural differences among the cities compared, although partially controlled for by the DiD methodology, may also have influenced the findings. Furthermore, the generalizability of the results is limited, as the study focused on the specific context of Brazilian cities, which may not reflect the realities of other regions. The temporal analysis, centered on 2022–2023, may also fail to capture the long-term effects of the program's implementation.

The findings of this study have important implications for public health practice and policy. The evidence that the PMMC significantly improved some of the main health indicators suggests the need for expansion and continuity of medical residency programs in PHC. These programs are essential to ensure that Basic Health Units (BHS) are staffed with qualified professionals capable of delivering comprehensive and continuous care. Additionally, areas such as childhood vaccination and cytopathological screening may require complementary approaches, such as strengthening public health campaigns and improving the distribution of supplies and technologies, in order to achieve more substantial results.

The role of the Family and Community Physician within the context of Primary Health Care (PHC) is essential for fostering effective interprofessional practice. This professional plays a central role in interacting with the Family Health team, promoting the articulation of diverse knowledge and competencies to deliver integrated, user-centered care.

Interprofessional practice involves active collaboration among physicians, nurses, community health agents, dentists, and other team members with the aim of planning, implementing, and evaluating health interventions in a coordinated manner[24]. The Family Physician contributes a broad and longitudinal perspective on care, facilitating early identification of health needs, shared management of chronic conditions, and appropriate referrals in more complex cases.

Furthermore, the Family Physician acts as an integration agent, promoting regular team meetings for case discussions, development of individualized therapeutic plans, and continuing education. This work model strengthens bonds within the team and with the community, increases PHC's problem-solving capacity, and contributes to improved health indicators and user satisfaction. Interprofessional practice, therefore, not only enhances clinical outcomes but also fosters an environment of learning and mutual support, promoting the continuous development of all professionals involved in care.

For future research, it would be valuable to monitor the long-term effects of medical residency programs in PHC, assessing the sustainability of observed impacts. Moreover, exploring the specific mechanisms through which the presence of family physicians influences various health indicators, including the quality of physician-patient interaction and integration with other levels of care, may provide additional insights. Expanding this type of analysis to other regions of Brazil and international contexts would also be useful for comparing the effects of medical residency programs across different health and social settings. Qualitative studies could complement the quantitative findings by offering a deeper understanding of health professionals' and patients' experiences with these programs. Additionally, studies using anonymized microdata from health information systems would allow for the adjustment of models based on individual determinants (income, education, race/skin color), thus reducing residual bias. Combining these quantitative findings with semi-structured interviews with managers, professionals, and users will help explain contextual mechanisms that underlie the observed variations.

CONCLUSION

The results of this study demonstrate the positive impact of the PMMC on improving health indicators related to PHC in the municipality of Campinas, particularly in maternal and child care and the management of chronic conditions. A significant increase was observed in prenatal consultation coverage, syphilis and HIV testing, dental follow-up for pregnant women, and hypertension control, indicators directly influenced by the integration of family and community physicians into PHC teams.

The PMMC's innovative approach, including the implementation of medical residency programs, not only contributed to the retention of qualified professionals but also strengthened care pathways and intersectoral coordination. Actions such as shared consultations, interprofessional practice, support group formation, community activities, and partnerships with local organizations enhanced patient adherence to treatment and reinforced continuity of care. These initiatives also proved essential in overcoming access barriers and promoting a care model that is more responsive to local needs.

Despite the improvements achieved, this study also highlighted areas in which PHC can be enhanced, such as increasing childhood vaccination coverage and cervical cancer screening, which still require complementary efforts and greater integration of public policies. These areas represent challenges that can be addressed through stronger educational campaigns, more equitable distribution of supplies, and strategies for community engagement.

This work contributes to the understanding of the impact of public policies directed at PHC and reinforces the relevance of programs such as the PMMC in promoting equity and quality in public health. Furthermore, future qualitative studies may offer deeper insight into the experiences of professionals and service users, complementing the quantitative findings presented here.

In summary, the PMMC presents itself as an effective model for strengthening PHC, contributing to significant advancements in the organization of health care, professional training, and the promotion of population health. Its expansion and continuity may serve as an inspiration for other regions, consolidating PHC as the foundation for more just and sustainable health systems.

CRediT author statement

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All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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