Original Article

The Effective Coverage of Maternal and Child Primary Health-Care-Services and its Relationship with Health-Expenditures: An Analysis at Sub-National-Level in Iran

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ABSTRACT

Introduction: The primary health care (PHC) approach is widely acknowledged as a fundamental element in achieving universal health coverage (UHC) goals. Consequently, numerous countries have undertaken efforts to restructure their health systems based on PHC principles. This study aims to evaluate geographic disparities in essential maternal and child indicators provided at the PHC level, focusing on both crude and effective coverage. Additionally, it seeks to explore the association between effective coverage and health expenditures within the national and sub-national contexts of Iran.

Methods: This research employed a secondary analysis approach to investigate the spatial distribution of maternal and child health (MCH) indicators in Iran's provinces, utilizing the latest available data from the 2010 Demographic Health Survey (DHS). To provide a comprehensive understanding of MCH indicators, the study calculated composite indicators, crude, and effective coverage. The provinces' situations were compared using the median cut-off method. Additionally, the study examined the association between coverage indicators and total health expenditure per-capita.

Results: At the national level, the crude and the effective composite coverage were 89.56% and 77.22%, respectively. Also, the medians of composite crude and effective service coverage in the provinces were 90.25% and 77.62%, respectively. There was no significant difference between urban and rural areas.

Conclusion: This study has revealed a notable difference between the crude and effective service coverage of the selected MCH indicators. While the coverage of maternal services was generally higher than that of child services, there were significant geographic disparities in the coverage of key indicators of MCH services across provinces. Despite the provision of free services in rural areas, their coverage was not higher than that of urban areas. These findings suggest that PHC services in Iran are still far from achieving the desired coverage and UHC goals. Policymakers and stakeholders need to focus on addressing the gaps in effective coverage and geographic disparities to improve access to essential maternal and child health services and achieve UHC in Iran.

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Introduction
Primary Health Care services in the World and Iran

The concept of primary health care (PHC) was first introduced in the Alma-Ata Declaration of 1978, where it was recognized as a fundamental strategy for organizing health systems.[1] In the past four decades, numerous countries have made efforts to restructure their health systems based on PHC principles. The PHC approach has gained recognition as a critical element in achieving global goals for Universal Health Coverage (UHC), as highlighted in the Astana Declaration of 2018.[2,3] Iran has also endeavored to align its health system with these global goals, demonstrating a commitment to improving access to essential health services for its population.[4]

PHC transitional periods in Iran

PHC in Iran has undergone five distinct phases of development:

1- The first phase (1972-1983) involved the Rezaieh study, conducted in collaboration with the World Health Organization (WHO),[5,6] which led to the establishment of health houses to provide PHC services in rural areas.

2- During the second phase (1984-1995), health care networks, health houses, and Community Health Workers (known as Behvarz) training centers were developed.

3- The third phase (1996-2005) saw revisions to the selection and training of Behvarzes,[7] as well as the launch of the Rural Family Physician Program and Rural Citizens Health Insurance Program, which

helped establish the health referral system for rural populations.[5,8]

4- The fourth phase (2006-2018) saw the implementation of a series of comprehensive health reforms known as the Health Transformation Plan (HTP), aimed at achieving UHC by 2014.[9] The HTP included revising earlier programs and the establishment of new programs aimed at integrating essential non-communicable diseases (NCDs) services into the PHC setting, improving public health interventions, empowering health workforces, establishing PHC health facilities in urban and suburban areas, improving the electronic data recording system, and promoting public health literacy.[9]

5- Currently, in the fifth phase (since 2019), Iran is committed to implementing the Astana Declaration,[3] which emphasizes the importance of PHC in achieving UHC. The PHC program in Iran has achieved notable successes, including a significant reduction in maternal and neonatal mortality rates and high coverage of universal vaccination. Overall, the development of PHC services in Iran has been a gradual process, spanning several decades, and reflecting a commitment to improving access to essential health services for all segments of the population.[10]

PHC main measurements and target groups

The concept of UHC recognizes the importance of quality health services in addition to the availability of services. While crude coverage (CC) is a measure of access

and utilization of health services, effective coverage (EC) takes into account the quality of services provided. Effective coverage is a comprehensive measure that considers intervention need, use, and quality, providing a more accurate reflection of the outcomes of PHC services. Therefore, the outcome of PHC services can be measured with the mentioned indicators.[11]

In Iran, two critical target groups of PHC services are mothers and children under five years old.[4] The health-related indicators for these groups are evaluated under the third goal of the Sustainable Development Goals (SDGs). To compare PHC system performance across different provinces of Iran, composite indicators were developed for both crude and effective coverage.[12,13]

Total health expenditure (THE) per capita is an important factor in achieving UHC, as the amount of funding allocated to the health system, including the PHC sector, can significantly impact the quality and availability of services.[14] Therefore, this study aimed to assess sub-national variations in key maternal and child indicators provided at the PHC level in terms of their crude and effective coverage across the country and investigate the relationship between these coverage indicators and health expenditures across different regions of Iran.

Materials and Methods

This study presents a secondary analysis of the most recent data available from the Demographic and Health Survey (DHS-2010), which is a combination of DHS-6 and Multiple Indicators Survey (MICS)-4.[15] The sample size for this study included 31,350 households.[16] The data were analyzed at both the national and provincial levels, encompassing all 31 provinces, with a focus on disaggregating the data by place of residence (urban/rural areas) and gender. To provide a comprehensive assessment of PHC services, both crude and effective coverage were calculated for each indicator separately, and composite crude and composite effective coverage were calculated for each category of indicators. Finally, the relationship between these two composite indicators and health expenditure per capita was assessed at the sub-national level.

Indicators of Crude Coverage and Effective Coverage for maternal and child at the PHC services

We selected a range of key maternal and child health services to study the geographical distribution of health service utilization at the district level. The indicators and the definition of their CC and EC are presented in Table 1.[17]

Composite Coverage Index- CCIs (Crude and Effective)

The Composite Coverage Index (CCI) is a summary measure of health service coverage that combines several indicators of preventive and curative interventions related to maternal and child health care. In this study, the CCI was calculated as a weighted average of six interventions that are critical for ensuring the continuum of care for mothers and children in Iran. These interventions include: (i) antenatal care coverage visits by a skilled provider; (ii & iii) screening for pregnancy diabetes and hypertension; (iv) oral rehydration therapy

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Table1. Definition of selected indicators, target population, Crude Coverage (Use) and Effective Coverage (quality) of services

	Indictor	Target Population	Crude Coverage (Use and Access)	Effective Coverage (Quality)
Mother	Coverage of antenatal care (ANC)	Women aged 15–49 who have cared during pregnancy and prenatal period.	The percentage of women aged 15-49 with a live birth in a given time period that received antenatal care for at least one time	Percentage of women aged 15–49 with a live birth in a given time period, attended at least four times during pregnancy by any provider (skilled or unskilled) for reasons related to the pregnancy.
	Prenatal diabetes screening	Women aged 15–49 who Screening for diabetes during pregnancy	The percentage of women aged 15-49 with a live birth in a given time period that received antenatal care for at least one time	Percentage of pregnant women who have been screened in terms of Diabetes in prenatal period.
	Prenatal hypertension screening	Women aged 15–49 who Screening for Hypertension during pregnancy	The percentage of women aged 15-49 with a live birth in a given time period that received antenatal care for at least one time	Percentage of pregnant women who have been screened in terms of Hypertension in prenatal period
Child	Coverage of care for children aged <5 who had diarrhea	Percentage of children aged <5 who had diarrhea	Percentage of children aged <5 who had diarrhea in the two weeks prior to the survey who were taken to an appropriate health provider	Percentage of children aged <5 who had diarrhea in the two weeks prior to the survey and received oral rehydration salts
	Coverage of care for children aged <5 who had pneumonia	Percentage of children aged <5 with pneumonia symptoms	Percentage of children aged <5 with pneumonia symptoms in the two weeks prior to the survey who were taken to an appropriate health provider	Children aged <5 years with ARI symptoms who took antibiotic treatment
	DTP3 vaccine coverage	Children aged 12-23 months who have received DTP3 vaccine.	Percentage of one-year-old children who have received three doses of the combined diphtheria, tetanus toxoid and pertussis (DTP3) vaccine in a given year	Serology evaluation after vaccination can be considered as effective coverage of this vaccine, but such evaluation is not performed in Iran

among children under five years old with diarrhea; (v) suspected acute respiratory infection care-seeking among children under five years old; and (vi) Diphtheria-Pertussis- Tetanus (DPT) 3- three doses for immunization against these diseases.[18]:

$$CCI = \frac{1}{2\left[\left(\frac{Pneumonia + Diarrhea + (2*DTP3)}{4}\right) + \left(\frac{Blood\ pressure + Diabetes + ANC}{3}\right)\right]}$$

$$CEI = \frac{1}{2\left[\left(\frac{Pneumonia + Diarrhea}{2}\right) + \left(\frac{Blood\ pressure + Diabetes + ANC}{3}\right)\right]}$$

The CCI assigns equal weight to four stages in the continuum of care for maternal and child health services. However, the coverage

of Diphtheria-Pertussis-Tetanus (DTP3) immunization is given a weight of two, as more than one dose of the vaccine is required to achieve full protection against these diseases. This weighting scheme ensures that the CCI accurately reflects the importance of each intervention in improving health outcomes for mothers and children in Iran.[18]

Relationship between CC and EC indicators at the provincial level

To examine the relationship between CC and EC indicators at the provincial level in Iran, Pearson correlation was employed. A scatter plot was then generated to visualize this relationship. The chart was divided into four zones by applying a number of cut-offs to investigate geographic variations among provinces. The first, second (median), and third quartiles were calculated to represent the distribution of CC and EC indicators among provinces. The second (median) quartile was depicted on the scatter plot using a solid line as the primary cut-off. The first and third quartiles were also illustrated on the scatter plot with dash-lines as alternative cut-offs to provide a more detailed assessment of provincial performance based on these indicators. Moreover, the provincial map of crude and effective coverage was presented using the same cut-off points (i.e., the first to the third quartile). The scatter plot was generated using R-software, while ArcGIS software was utilized to create the provincial map.

THE per capita and its effect on composite effective coverage

To compare the relationship between THE per capita and composite effective coverage, THE per capita in 2010 was extracted.[19] A bubble plot was generated to illustrate the relationship between THE per capita and CEC, with the linear regression fit model and confidence interval calculated while considering population weight. Additionally, the relationship was investigated through plotting and fitting a linear regression fit model.

Results

This study's results are presented in four sections as follows:

A) Crude and Effective Coverage Indicators by Province, Gender, and Place of Residence

The results show that both crude coverage and effective coverage of the main MCH indicators vary by province, gender, and place of residence. The coverage ranges from 33.29% for receiving care for children with diarrhea in some provinces to 100% for antenatal care (ANC), DTP3 immunization, and screening for high blood pressure and gestational diabetes in pregnant women. Additionally, the results reveal differences in coverage between rural and urban areas as well as variations in CC and EC for different indicators.

B) Composite Coverage Index

i) National Level

At the national level, the composite crude

coverage (CCC) and composite effective coverage (CEC) averages for all MCH indicators were 89.56% and 77.2%, respectively. The province with the lowest CCC and CEC was Sistan-Baluchestan, with coverage rates of 81.6% and 63.6%, respectively. Markazi province had the lowest CCC for diarrhea treatment (38.4%), while Kermanshah had the lowest CEC for the same indicator (33.3%). Maternal care indicators had the highest rates of CCC and CEC, with coverage rates of 97.2% and 92.5%, respectively. However, for the DTP3 indicator, only the crude service coverage was reported among provinces, as information on the quality of the provided interventions was not available to calculate the CEC.

ii) Subnational Level

The provincial distribution of MCH indicators is presented in Figure 1, revealing a non-uniform distribution across provinces. The findings indicate that the provinces with high crude coverage did not necessarily have high effective coverage. Notably, four provinces (Semnan, Bushehr, Lorestan, and Chaharmahal-Bakhtiari) had sufficient coverage and effective provision of PHC interventions. In contrast, Sistan-Baluchestan had the poorest crude and effective coverage among provinces.

iii) Urban and Rural Level

The study also examined the differences in MCH service coverage between urban and rural areas. The results show that crude coverage was slightly higher in urban areas (90.2%) compared to rural areas (88.6%).

However, effective coverage was higher in urban areas (79.3%) compared to rural areas (73.9%).

C) Performance Assessment of Provinces in PHC based on Crude and Effective Coverage Providing MCH Services

To assess the performance of provinces in providing MCH services at the PHC level, Figure 2 plots composite crude service coverage against composite effective coverage or quality of care for each province. The median values of crude and effective coverage were 90.2% and 77.6%, respectively, and were selected as the main cut-off points and shown on the chart with a solid line. By applying these cut-offs, the figure was divided into four zones, and the provinces located in the lower-left zone were identified as the lowest-performing provinces, while those in the upper-right zone were identified as the highest-performing provinces in the provision of maternal and child PHC services.

The dash-line on the scatter plot displays the performance of provinces using the first and third quartiles, which were 89.2% and 92.2% for CC, and 73.9% and 81.7% for EC, respectively. Sistan-Baluchestan province had the lowest values of both crude and effective coverage of services. The provinces of Lorestan, Bushehr, Semnan, and Gilan had acceptable levels for both indicators.

D) The Relationship between Composite Indicators and Total Health Expenditure (THE) per Capita

The relationship between THE per capita and composite coverage index (CCI), considering

population weight, is illustrated in Figure 3. The results indicate that Sistan-Baluchestan province had the lowest THE per capita and low coverage levels for MCH services. In contrast, Fars province had the highest THE per capita and appropriate levels of coverage,
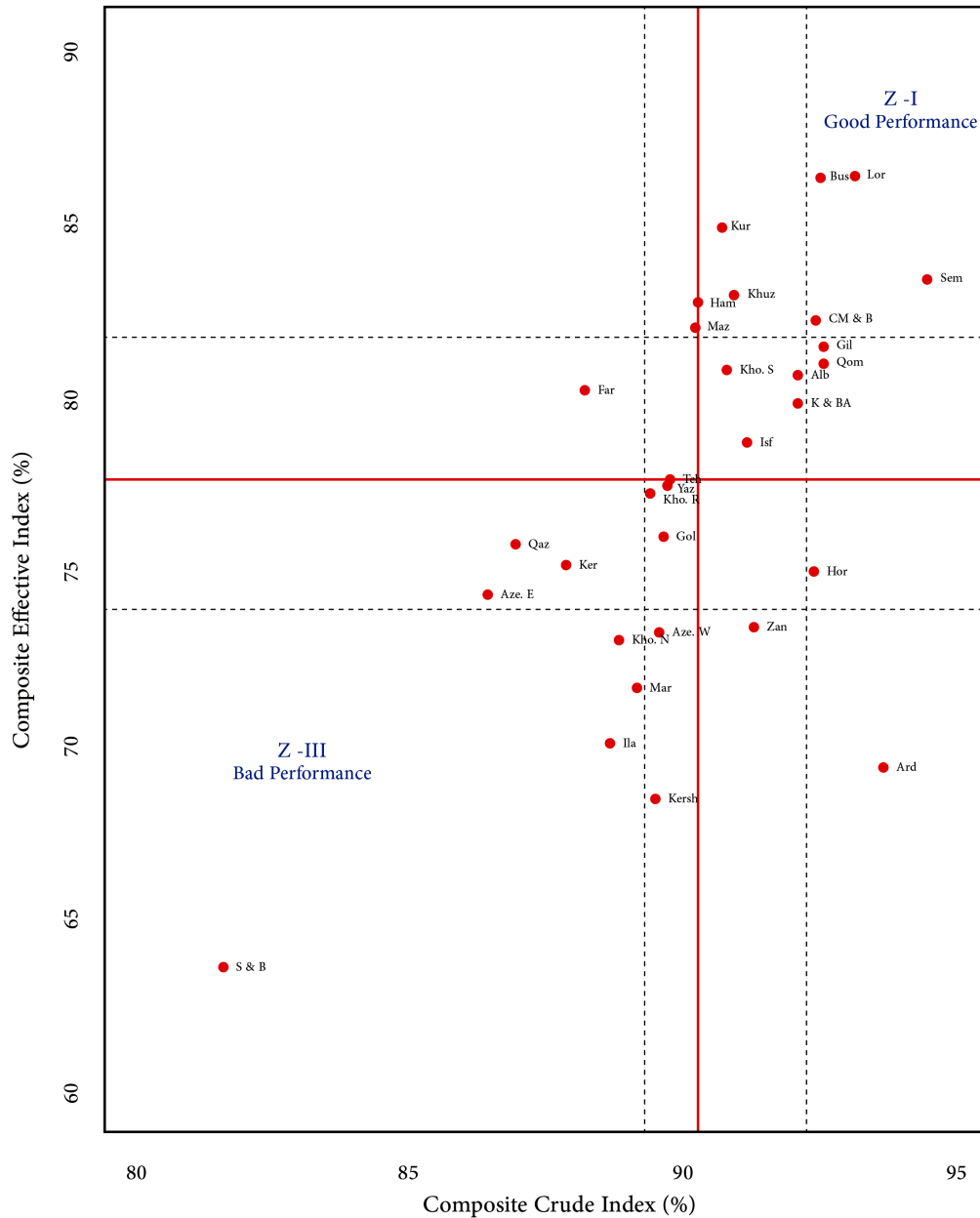

Figure 1. Composite effective coverage index against composite crude coverage index by provinces in 2010
Hor, Hormozgan; Kho N, Khorasan North; Aza E, Azarbaijan East; Ker, Kerman; S&B, Sistan-Baluchistan; Alb, Alborz; Isf, Isfahan; CM&B, Chahar Mahal and Bakhtiari; Teh, Tehran; Aza W, Azarbaijan West; Khuz, Khuzestan; Kersh, Kermanshah; Nat, National; Lor, Lorestan; Sem, Semnan; Kho R, Khorasan Razavi; Kho S, Khorasan Soath; Gil, Gilan; Maz, Mazandaran; K&BA, Kohgiluyeh and Boyer Ahmad; Kor, Kordistan; Qom, Qom; Far, Fars; Ham, Hamedan; Yaz, Yazd; Ila, Ilam; Mar, Markazi; Gol, Golestan; Zan, Zanjan; Bus, Bushehr; Qaz, Qazvin
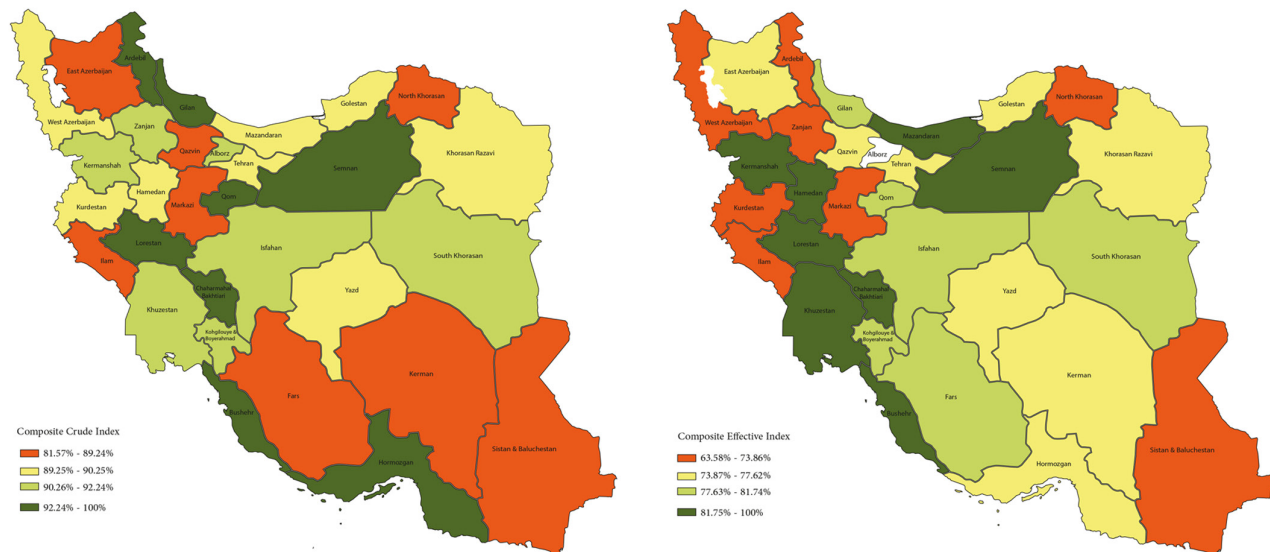
Figure 2. Composite crude and effective Coverage of primary health care services (six Interventions) in 31 provinces

Table 2. Regression fit between health expenditure per capita and the effective services coverage of PHC services in 2010

	Coefficients			
	Estimate	Std. Error	t value	Pr (>|t|)
THE	0.002801	0.003742	0.749	0.46
P-value	0.4601			

indicating a direct relationship between the two values. However, this direct relationship was not observed in Alborz province, which had relatively good coverage with a low per capita THE.

To further investigate the relationship between health expenditures and service coverage, a linear regression fit model was employed. The results, presented in Table 2, show that there was no statistically significant relationship between health expenditures and service coverage for maternal services, child services, or both.

Discussion

The present study aimed to estimate the sub-national level of crude and effective coverage of key maternal and child PHC services and investigate the impact of health expenditures per capita on coverage in Iran. The results revealed a gap between crude and effective coverage of PHC indicators, with maternal health interventions having higher coverage than children's health interventions. Furthermore, health expenditures per capita had no significant relationship with effective service coverage, and the provinces with the lowest coverage also had the lowest per capita health expenditures.

The indicators measured in this study are fundamental components of PHC interventions aimed at improving MCH. Based on the findings of this study, achieving
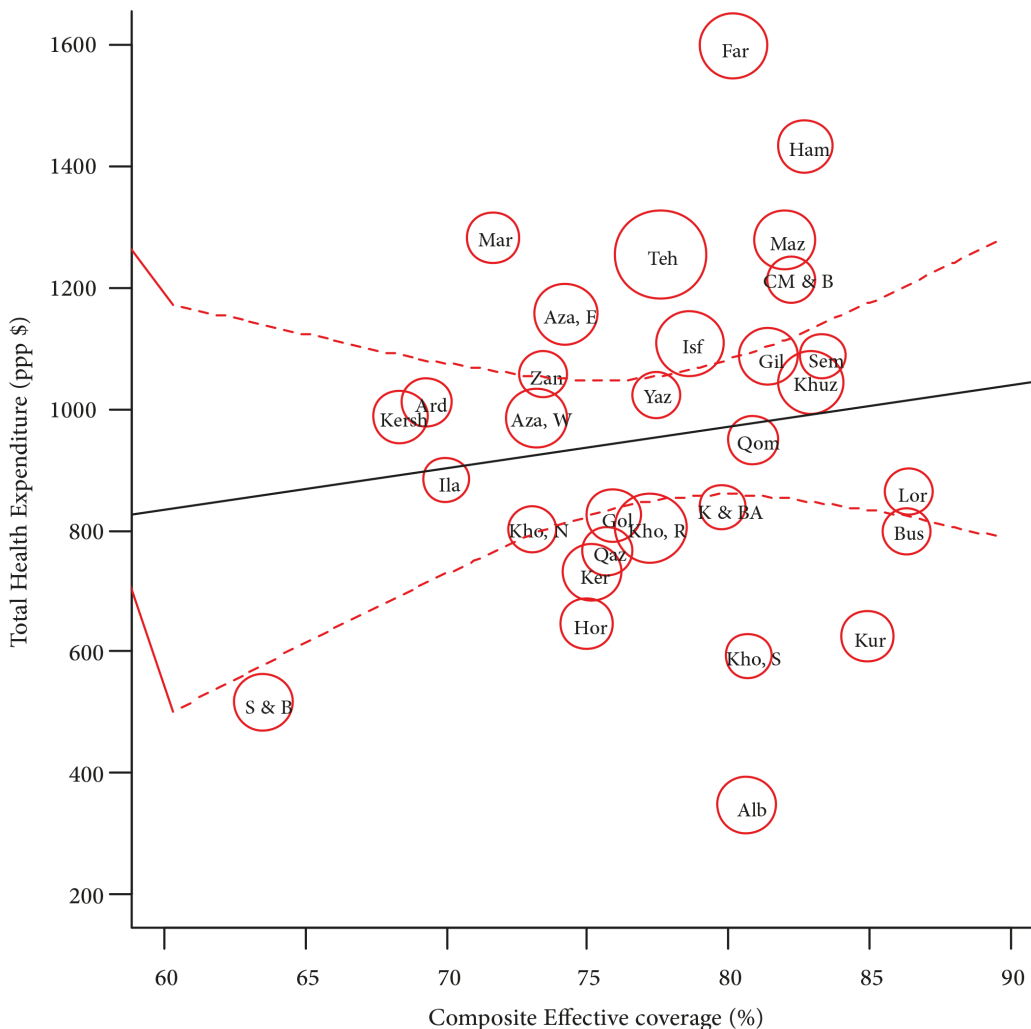
Figure 3. Relationship between composite effective coverage (six Interventions) by provinces and Total Health Expenditure per capita

Hor, Hormozgan; Kho N, Khorasan North; Aza E, Azarbaijan East; Ker, Kerman; S&B, Sistan-Baluchistan; Alb, Alborz; Isf, Isfahan; CM&B, Chahar Mahal and Bakhtiari; Teh, Tehran; Aza W, Azarbaijan West; Khuz, Khuzestan; Kersh, Kermanshah; Nat, National; Lor, Lorestan; Sem, Semnan; Kho R, Khorasan Razavi; Kho S, Khorasan Soath; Gil, Gilan; Maz, Mazandaran; K&BA, Kohgiluyeh and Boyer Ahmad; Kor, Kordistan; Qom, Qom; Far, Fars; Ham, Hamedan; Yaz, Yazd; Ila, Ilam; Mar, Markazi; Gol, Golestan; Zan, Zanjan; Bus, Bushehr; Qaz, Qazvin

UHC at the national level in Iran remains a challenge, despite some progress made. There is still a long way to go to attain the desired coverage. Although essential health services are more widely available in rural areas of the country, the coverage of all included indicators, particularly the effective coverage indicators, is still lower than in urban areas. This indicates a need for further investigation to identify the underlying causes of the disparity.[20]

The study also highlights the importance of

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considering the location of received PHC services (public/private) in future surveys and examining patients' satisfaction levels with the quality of care they receive. Geographic distribution of a range of PHC services coverage is an essential aspect of evaluating health system performance worldwide.[21] The World Health Organization has introduced the CCI to measure countries' performance regarding UHC. After introducing UHC as the main target of SDGs, the WHO has introduced the CCI, which measures countries' performances.[18] Accordingly, similar studies performed in Mexico,[22] Bangladesh,[23] and worldwide[12] have evaluated the performance of their health systems using a set of composite indicators.[22]

Fourteen out of 31 provinces in Iran performed well in providing PHC services, with four provinces located above the third-quarter zone demonstrating excellent performance. However, in per capita expenditure estimation, these provinces did not necessarily have high per capita costs, indicating that optimal performance was not necessarily associated with higher per capita expenditure. Sistan-Baluchestan province, with the most unfavorable indicators, had lower per capita expenditures compared to other provinces, highlighting the need to revise the allocation of resources to low-income provinces. Overall, these findings have important implications for policymakers in Iran and other countries seeking to improve MCH service coverage and achieve UHC goals.

The source of information for this study was the Iranian Demographic and Health Survey, and no other similar household surveys have been conducted since 2010. Given the implementation of the Health Transformation Plan (HTP) in 2014[9] to accelerate progress towards UHC in Iran, it is crucial to conduct a similar survey to assess the current performance of PHC and evaluate the effect of the HTP on achieving UHC goals.

The findings of this study showed that the PHC system in Iran has reached acceptable performance in terms of screening NCDs in the population studied. However, to assess the performance in preventing and controlling NCDs, conducting an assessment on the general population is crucial. Accordingly, the importance of conducting regular surveys and evaluations to monitor the performance of PHC systems to effectively address the population's health needs is highlighted.

Regular assessments of PHC service coverage and quality are essential to monitor progress towards achieving UHC and ensuring equitable access to essential health services for all.

Geographic disparities in the coverage of MCH indicators can reveal the existing inequities within and between countries, as demonstrated in this study.[24] The findings indicate that Sistan-Baluchestan province had the lowest maternal indicators, highlighting the need to tailor interventions in each province according to their specific population needs, rather than implementing a standardized plan for all provinces.

To address such inequities and improve the performance of PHC systems, WHO has recently developed the PHC Measurement and Improvement (PHCMI) initiative, which has been implemented in Iran. This initiative aims to promote equitable access to essential health services and ensure that all individuals, regardless of their location or socioeconomic

status, receive high-quality care that meets their specific health needs.[25,26]

The maternal mortality rate in Iran has been decreasing, with a current ratio of 16 per 100,000 live births, indicating a significant decrease compared to the rate in 2010. This decline suggests that the measures taken to improve maternal care in Iran have been effective.[27,28]

High immunization coverage has also been a major achievement of the Iranian health system,[29] with the country receiving certification for the elimination and eradication of several infectious diseases, including polio,[30,31] measles, and rubella.[32] Vaccination is provided free of charge in all state-owned health centers, and the DTP3 vaccine has recently been replaced by the Pentavalent,[33] which should be considered in future assessments.

Despite these successes, the coverage of care for diarrheal and acute respiratory infection diseases is lower than for other indicators studied.[34] The under-5 mortality rate has shown a declining trend since 2010 (15.3 to 9.4), but it is essential to consider that these diseases might still contribute to children mortality and should be addressed in future assessments.[10,28,35]

In 2010, the share of PHC services from total health expenditure in Iran was 4.9%, which decreased slightly to 4.7% in 2017. Despite an increase of approximately 26% in THE per capita in 2017 compared to 2010, the share of PHC services from THE remained relatively stable. This observation may pose challenges for PHC expansion initiatives and highlights the need for further investment in PHC services.[35] WHO has recommended that the share of PHC in the public budget should be sufficient to ensure that countries move towards achieving UHC. In Iran, this share is estimated to be 47.9%, which is higher than the estimated average of less than 40% at the global level. This indicates that Iran has made significant progress in prioritizing PHC services in its health budget, which can contribute to improving the accessibility and quality of essential health services for its population.[36]

Conclusion

To achieve the goals of universal health coverage, it is essential to focus on both the quality of PHC services and their accessibility. In Iran, the concept of effective coverage in health care has not yet been incorporated into the health system performance assessment. Additionally, there is a need to assess the quality of data to identify the strengths and weaknesses of the country's PHC system. Assessing PHC performance based on recently proposed frameworks such as PHCMI can provide a comprehensive understanding of the PHC system's performance.

It is noteworthy that Iran has a top-down centralized PHC system, and although the average PHC performance is satisfactory, some deprived provinces experience substantial challenges. To address this issue, it is recommended that PHC plans be formulated across the country and implemented based on local health needs and priorities. Policymakers should also focus on enhancing the quality of health services, particularly for services that have relatively high utilization, to optimize population health outcomes.

Given the relatively low share of PHC services from THE. There is a need to allocate

additional public funds to the PHC network. Furthermore, strengthening the quality of essential PHC services provided for children is crucial, as their health indicators are still far from reaching the intended target.

Strengthening the PHC system is a critical step towards achieving UHC in Iran. To achieve this goal, it is necessary to consider national and sub-national needs and priorities, focus on enhancing the quality of PHC services, allocate additional public funds to the PHC network, and prioritize the provision of high-quality essential services for children. The incorporation of effective coverage indicators into the health system performance assessment can also provide a more comprehensive understanding of the PHC system's performance and help address existing health inequities.

Conflict of interest statement

The authors declare that there are no conflicts of interest related to this study.

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