

# Mean population salt intake in Iran: A systematic review and meta-analysis

Sirous Pourkhajoei<sup>1</sup> | Vahid Yazdi-Feyzabadi<sup>2</sup> | Mohamadreza Amiresmaeili<sup>3</sup> |  
Nouzar Nakhaee<sup>4</sup> | Reza Goudarzi<sup>4</sup>

<sup>1</sup>Faculty of Management and Medical Information Sciences, Kerman University of Medical Sciences, Kerman, Iran

<sup>2</sup>Social Determinants of Health Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

<sup>3</sup>Health in Disasters and Emergencies Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

<sup>4</sup>Health Services Management Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

## Correspondence

Reza Goudarzi, Health Services Management Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran.

Email: [rgoudarzi@yahoo.com](mailto:rgoudarzi@yahoo.com)

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## Abstract

**Introduction:** High salt intake has been connected with the increase of many non-communicable diseases (NCDs) worldwide. Like other middle-income countries, Iran is experiencing a considerable increase in NCDs, necessitating attempts to reduce dietary salt intake. As in Iran there is uncertainty about the existing rate of salt intake. The present study aimed to estimate mean salt intake of Iranian population by systematically reviewing existing literature.

**Methods:** This research is a systematic review and meta-analysis (PRISMA Protocol) of published article data, with no time constraint until the end of 2020, to estimate mean salt intake of Iranian population. A comprehensive literature search was performed on international databases of Medline, Science Direct, PubMed, Embase, Scopus, Springer, Online Library Wiley, Web of Science, Cochrane, and Google Scholar and domestic data bases of Iranmedex, Magiran, SID, and Medlib. Subgroup analysis was conducted for gender, region, measurement method, and age group. Research homogeneity was evaluated by  $I^2$  statistic. We reviewed all studies which met inclusion criteria. STATA Ver.13.1 was used to perform meta-analysis.

**Results:** Meta-analysis of data from 32 studies showed that the average salt intake in all ages was 9.674 g/day (95% CI, 9.033–10.316 g/day). The lowest estimation of salt intake was 9.33 g/day (95% CI, 7.75–10.91 g/day) which was estimated from studies which used point collection method, and the highest estimate using the food reminder questionnaire was 10.41 g/day (95% CI, 8.49–12.34 g/day). Also, the average weight salt intake for men over 18 years old in different cities was 10.39 g/day (95% CI, 9.01–11.78 g/day), for women over 18 years in different cities 9.52 g/day (95% CI, 8.42–10.62 g/day), and children and adolescents was estimated at 5.664 g/day (95% CI, 2.91–8.41 g/day).

**Conclusion:** The intake of salt in the Iranian population is near twice the WHO recommendation. Therefore, it is necessary to consider effective strategies and interventions to reduce dietary salt intake in Iran as a health priority.

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## KEYWORDS

Iran, meta-analysis, salt intake, sodium, systematic review

## 1 | INTRODUCTION

High salt intake has been associated with the development of many non-communicable diseases (NCDs) worldwide.<sup>1</sup> The high salt intake appears to be harmful to humans and is a primary cause of several NCDs with a detrimental effect on blood pressure.<sup>2</sup> Excessive salt intake is associated with kidney disease, an increased risk of obesity, osteoporosis, and gastric cancer.<sup>3,4</sup> It also increases the risk of cardiovascular diseases (CVDs), cardiac thrombosis, asthma, and gastric ulcer.<sup>5</sup> Excessive salt intake is the world's seventh leading cause of death responsible for cardiovascular disease,<sup>6</sup> Generally accounting for 20% of cardiac deaths, 13% of stroke deaths, and 11% of deaths from ischemic heart disease.<sup>7</sup> The World Health Organization (WHO) has set salt reduction as the main priority in the fight against NCDs.<sup>8</sup> Many studies have found that lowering daily salt intake can greatly improve patients' health.<sup>9,10</sup> According to a UK study, cutting salt intake to 6 g/day could save the lives of 2.5 million individuals globally from stroke and ischemic heart disease.<sup>11</sup> In general, a decrease in salt intake to 5 g/day results in a 23% reduction in strokes and a 17% reduction in CVDs risk factors.<sup>12,13</sup> As a result, the WHO recommends that individuals consume 5 g/day.<sup>14</sup> To that end, WHO member countries have committed to a 30% reduction in salt intake by 2025.<sup>15</sup> Although the recommendation of 5–6 g of salt per day would have a major effect on blood pressure and cardiovascular disease reduction, it could be regarded as a satisfying solution. Indeed community would benefit from further reduction of salt intake (3 g daily salt intake) in the form of much greater prevention of related diseases,<sup>16</sup> it is extremely effective for disease prevention, particularly in low- and middle-income countries.<sup>17</sup> It is one of the most cost-effective strategies for lowering premature death and disability in these societies.<sup>18</sup> Like other middle-income countries, Iran is experiencing a considerable increase in NCDs, necessitating attempts to reduce salt intake in Iran.<sup>19</sup> As a result, data characterizing the problem's nature and magnitude are necessary. The national salt reduction policy should be executed in accordance with current knowledge regarding the mean salt intake in the country. This study was conducted with the aim of systematic review and meta-analysis of the mean salt intake in Iran.

## 2 | METHOD

The current study provides a systematic review and meta-analysis (PRISMA Protocol) of published article data, with no time constraint until the end of 2020, to characterize the mean salt intake of Iranian populations.

## 2.1 | Data sources and search strategy

National and international electronic databases, including Medline, Science Direct, PubMed, Embase, Scopus, Iranmedex, Magiran, SID, Springer, Online Library Wiley, Web of Science, Medlib, Cochrane, and Google Scholar, were searched for related articles using the keywords of "sodium" or "salt," "Iran," and "intake," "ingest\*," "eat\*," "consume\*," "diet\*," "urine\*," or excrete. Due to the insensitivity of national databases to search operators (AND, OR, NOT), the search on these databases was restricted to Persian keywords (S.P.; V.Y.-F.). We reviewed the sources of the articles to see if there were any further relevant articles. At the end of the search, two authors separately (S.P.; R.G.) reviewed the list of abstracts identified by them, as well as the full texts of the eligible abstracts. A third researcher (M.A.E.) reviewed the articles in disagreement between the two researchers.

## 2.2 | Inclusion and exclusion criteria

The analysis included studies that examined urine sodium using any collection method (such as urine stop sampling, overnight urine samples, and 12- or 24-h urine collection), daily dietary salt intake (Food Frequency Questionnaire (or any self-report method). There were no age or gender limitations in Iranian populations (men, women, and children). Studies with convenience sampling (Because the results are not generalizable to the community) or those on specific populations were excluded (e.g., patients with hypertension). Furthermore, we excluded papers for which we did not have full-text access.

## 2.3 | Quality assessment

The researchers employed the National Institute of Health (NIH) quality assessment checklists to assess the articles' quality. The NIH quality assessment forms were provided based on the study design (cohort, case-control, cross-section, etc.). Various aspects of bias sources, study rigor, and so on have been assessed.<sup>20</sup> Two referees assessed the quality of the studies (S.P.; R.G.). If the two authors differed about the study's results, a third researcher reviewed them.

## 2.4 | Data extraction

The authors provided the following information in Excel after reviewing the text of related studies: year of publication, year of data collection, city, the scope of the study (national or community-based study), sample size, salt intake in men and women (with SD), and sodium intake

reporting method. When studies did not report the mean daily salt intake in grams, multiple conversion formulas were employed to determine the average. A single researcher gathered the data, which was subsequently verified by another (S.P.). If there was a disagreement at this point, the third researcher reviewed the article (M.A.).

### 2.5 | Outcome measures

The mean population salt intake was estimated as g/day. Secondary results were also obtained based on the mean salt intake by sex, location, study type, and salt reporting method (urine or dietary analysis).

### 2.6 | Data synthesis

Because the mean and SD were the main indices evaluated in this study, the mean salt intake (with 95% CI) was estimated in the primary and secondary analyses using the inverse variance-weighted average method. The  $I^2$  statistic was used to assess the research homogeneity. Due to the homogeneity of the research, it was unnecessary to utilize different models for combination, because of zero  $I^2$  we applied fixed-effects meta-analysis. Begg's funnel plot was used to analyze publication bias. STATA was used to analyze the data (version 13.1) and a  $p$  value of less than 0.05 was considered statistically significant.

### 2.7 | Subgroup analysis

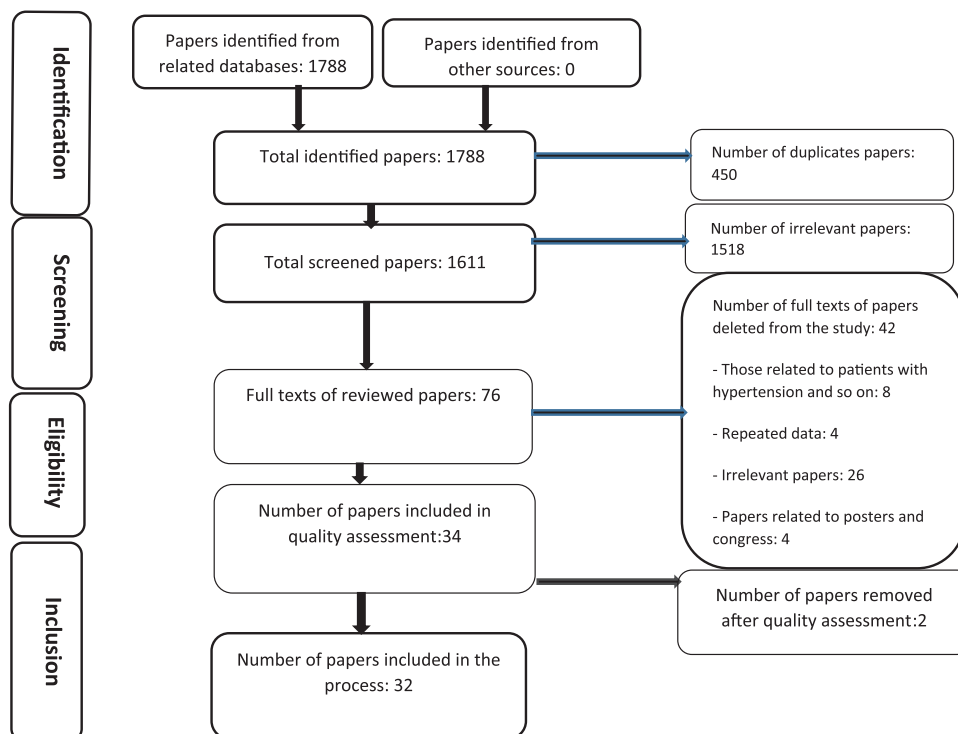
Given that some social, economic, geographical, and cultural parameters and the type of measurement tool may affect the pattern of behavior in salt intake, so sensitivity analysis was conducted for gender, region, measurement method, and age group. To analyze the sensitivity of the gender parameter, in studies reported aggregated results for both genders we classified them as both.

### 2.8 | Geographical distribution

We used Geographic Information System (GIS) to determine the prevalence of salt consumption by geographical area. GIS is the most important tool in providing statistics and disease information in the form of visual presentation.<sup>21</sup> Equal interval model was used, so that the distance between the province that had the highest amount of salt consumption and the province that had the lowest amount, is divided into five categories with equal interval.

## 3 | RESULTS

Out of 1788 abstracts, 1695 were removed due to duplication and irrelevance, and 76 papers were then reviewed. Finally, 32 studies met the inclusion criteria (Figure 1). The total number of samples in these studies, which gave information on Iran's provinces' daily



**FIGURE 1** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram for the selection of publications included in our analysis

**TABLE 1** The investigations of the salt intake of Iran, included in the meta-analysis

Study	Year	City	Sample	Method of Assessment	Mean salt intake g/day				
					All	Men	Women		
Page et al. <sup>22</sup>	1981	Ilam	130	Overnight urine samples	10.01	ND	ND		
Rahmani et al. <sup>24</sup>	2000	Ilam	75	Spot urine sample	9.98	ND	ND		
			61		11.6				
Azizp et al. <sup>25</sup>	2001	Rasht	327	Food Frequency Questionnaire	7.2	ND	ND		
		Sari	356		7.7				
Rafiei et al. <sup>26</sup>	2001	Isfahan	850	Sodium intake in a 24-h period	9.7	9.6	9.75		
Rafiei et al. <sup>27</sup>	2008	Isfahan	912	Sodium intake in a 24-h period	9.9	11.1	9.6		
Nazeri et al. <sup>28</sup>	2010	Tehran	639	Sodium intake in 24 h	ND	ND	9.67		
Motlagh et al. <sup>29</sup>	2010	Yazd	252	Food Frequency Questionnaire	ND	ND	10.09		
Nazeri et al. <sup>30</sup>	2010	Tehran	156	Sodium intake in a 24-h period	9.1	10.4	8.7		
Nazeri et al. <sup>31</sup>	2011	Tehran	242	Sodium intake in 24 h	9.3	ND	ND		
			1052		8.11			7.59	8.17
			374		13.29			14.29	11.49
Khosravi et al. <sup>23</sup>	2012	Isfahan	806	Sodium intake in 24 h	12.355	13.29	9.93		
			416		12.8	ND	ND		
Naghbi et al. <sup>33</sup>	2012	Sari	416	Food Frequency Questionnaire	12.8	ND	ND		
Kelishadi et al. <sup>39</sup>	2013	Isfahan	500	Spot urine sample	7.08 (child)	ND	ND		
Haghighat dost et al. <sup>34</sup>	2013	Isfahan	806	Sodium intake in 24 h	9.82	ND	ND		
Atazadegan et al. <sup>32</sup>	2014	Shiraz	68	Food Frequency Questionnaire	10.89	ND	ND		
Garipour et al. <sup>37</sup>	2014	Isfahan	410	Sodium intake in 24 h	10.44	ND	ND		
Moeini et al. <sup>52</sup>	2014	Isfahan	45	Spot urine sample	ND	ND	10.47		
			47		ND	10.23			
Mirzaei et al. <sup>38</sup>	2014	Yazd	213	Sodium intake in 24 h	9.13	10.02	7.56		
Jafari et al. <sup>50</sup>	2016	Kerman	310	Spot urine sample	9.5	ND	ND		
			346		8.8				
Mohammadifard et al. <sup>40</sup>	2017	Isfahan	796	Sodium intake in 24 h	10.77	11.03	10.17		
Soltani et al. <sup>43</sup>	2017	Yazd	195	Food Frequency Questionnaire	ND	ND	9.36		
Rafiei et al. <sup>41</sup>	2017	Isfahan	374	Sodium intake in 24 h	5.05(Child)	ND	ND		
Akhondzadeh et al. <sup>49</sup>	2018	Yazd	100	Sodium intake in 24 h	8.35	ND	ND		
Rezaei et al. <sup>42</sup>	2018	Iran	18635	Sodium intake in 24 h	9.68	9.74	9.32		
Mohammadifard et al. <sup>36</sup>	2019	Isfahan	183	Sodium intake in 24 h	9.5	9.6	9.5		
			51		9.7	9.76	9.86		
			218		9.6	10.31	9.2		
			402		10.02	11.43	9.28		
Arsang-Jang et al. <sup>35</sup>	2019	Isfahan	1059	Sodium intake in 24 h	9.9	9.71	9.81		
			374		10.06	10.31	9.81		
			806		10.29	11.43	9.28		
Abadi et al. <sup>44</sup>	2019	Yazd	110	Sodium intake in 24 h	9.35	9.82	8.87		

TABLE 1 (Continued)

Study	Year	City	Sample	Method of Assessment	Mean salt intake g/day		
					All	Men	Women
Ghorbani et al. <sup>53</sup>	2019	Isfahan	23	Sodium intake in 24 h	10.03	ND	ND
Khosravi et al. <sup>45</sup>	2019	Isfahan	1099	Sodium intake in 24 h	11.66	ND	ND
Mohammadifard et al. <sup>46</sup>	2020	Isfahan	79	Sodium intake in 24 h	9.54	ND	ND
Mohammadifard et al. <sup>47</sup>	2020	Isfahan	912	Sodium intake in 24 h	9.64	10.2	9.7
Layeghiasi et al. <sup>51</sup>	2020	Yasuj	166	Spot urine sample	14.34	ND	ND
Ghaseminasab parizi et al. <sup>48</sup>	2020	Shiraz	67	Food Frequency Questionnaire	ND	ND	8.42

Abbreviation: ND, no data.

population intake between 1980 and 2020, was 34,223 people. There were 27 cross-sectional studies ( $n = 33,186$ ),<sup>22-48</sup> one randomized controlled trial ( $n = 100$ ),<sup>49</sup> three case-control studies ( $n = 771$ ),<sup>2-50</sup> and one quasi-experimental research ( $n = 166$ ).<sup>51</sup> Two studies<sup>39,41</sup> involved children and adolescents, whereas four involved only women.<sup>29,43,48,52</sup> Table 1 shows the general characteristics and data of each study.

### 3.1 | Overall mean daily salt intake

Based on the data set (24-h urine, overnight, spot, and questionnaire) and fixed effects pooling model ( $I^2 = 0.0\%$ ), salt intake was estimated to be 9.674 g/day (95% CI, 9.033-10.316 g/day) for all ages (Table 2). Eliminating individual studies had no effect on the estimate. In addition, 21 studies estimated salt intake to be 9.655 g/day using a 24-h urine collection ( $n = 31058$ ) (95% CI, 8.878-10.432 g/day),<sup>23,26-28,30,31,34-38,40-42,44-47,49</sup> and five studies estimated salt intake to be 9.328 g/day using a stop urine sampling method ( $n = 1550$ ) (95% CI, 7.749-10.907 g/day).<sup>24,39,50-52</sup> One study estimated salt intake to be 9.403 g/day using overnight urine samples collection ( $n = 166$ ) (95% CI, 6.264-12.542 g/day) and six studies estimated salt intake to be 10.411 g/day using the Food Frequency Questionnaires ( $n = 1449$ ) (95% CI, 8.485-12.337 g/day)<sup>25,29,32,33,43,48</sup> (Appendix A1).

A funnel plot was used to check publication bias ( $p$  values for Begg's and Egger's tests were 0.33 and 0.183, respectively), which ruled out the possibility of bias (Figure 2).

### 3.2 | Subgroup analysis

Furthermore, 11 studies determined that the weighted mean salt intake for men over the age of 18 in diverse cities was 10.393 g/day (95% CI, 9.011-11.776 g/day).<sup>23,26-28,35,36,38,40,42,44,47</sup> It was 9.52 g/day for women over 18 years (95% CI, 8.42-10.62 g/day)<sup>23,26-29,35,36,38,40,42-44,47,48,52</sup> and 5.664 g/day for children and adolescents (95% CI, 2.915-8.414 g/day) in 15 studies<sup>39,41</sup>

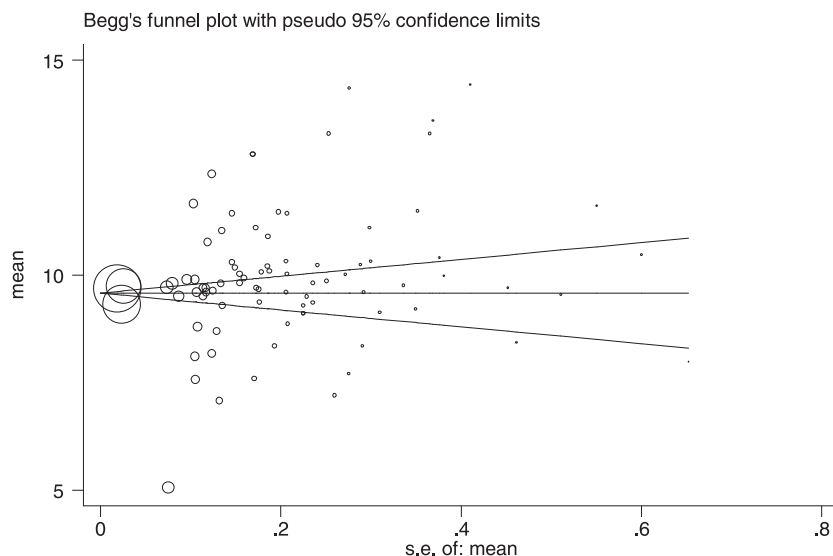
TABLE 2 Summary of fixed-effects meta-analysis of salt intake, Iran

Subgroups	Salt g/day (Overall)	95% CI	Number of studies
Measurement method			
24-h urine collection	9.65	8.88-10.43	20
Spot urine sample	9.33	7.75-10.91	5
Overnight urine samples	9.40	6.264-12.54	1
Food Frequency Questionnaire	10.41	8.49-12.34	6
Sex			
Men	10.393	9.011-11.776	11
Women	9.517	8.417-10.617	16
Both	9.975	8.947-11.003	25
Age group			
Children	5.66	2.915-8.414	2
Adults	9.905	9.245-10.565	30
Area of residence			
Urban	10.053	9.055-11.051	30
Rural	10.206	6.677-13.736	3

(Appendix B1). Also, the review of available data shows that the mean salt intake of rural residents (10.2 g/day) is greater than that of urban residents (10.05 g/day). A 24-h urine collection was used to assess the mean salt intake in all provinces and cities.

### 3.3 | Geographical distribution

The current study indicated high salt intake prevalence from south to northwest Iran. Among Iranian provinces, Lorestan residents consumed the most salt (13.05 g per day), while Bushehr residents consumed the least salt intake (8.16 g per day) (Figure 3).



**FIGURE 2** Publication bias for mean salt intake studies

## 4 | DISCUSSION

In the current systematic review, the mean population salt intake from 1981 to 2020 in Iran was estimated to be 9.674 g/day, that is, 4.674 g/day more than WHO recommendation. Although the mean salt intake was determined using a variety of methodologies (24-h, spot urine sampling, overnight urine samples, and Food Frequency Questionnaire), all of the data confirm that salt intake exceeds the WHO's NCDs prevention recommendation. Even at 9.4 g/day (overnight urine samples), the amount is twice the level recommended by the WHO. Two systematic review studies found that the mean salt intake in Australia was 9.6 g/day, 10.98 g/day<sup>54,55</sup> in India, and 10.49 and 12 g/day in Latin America and Asia, respectively.<sup>56,57</sup>

The difference in mean salt intake between studies is predictable because they have used different measuring tools. While 24-h urine collection is considered normal practice, there are reservations about its use due to the frequent sampling and high expense. As a result, various methods such as spot urine sampling, overnight urine samples, and planned urine tests have been examined to develop policies to reduce salt intake.<sup>58</sup> Because calculating salt intake using a 24-h urine collection is beyond the capabilities of many countries, effective interventions to reduce salt consumption, promote health, and prevent disease can be made based on the results of alternative methods.<sup>59</sup> One of the key factors contributing to excessive salt intake is a lack of awareness about the source and amount of salt taken by individuals,<sup>51</sup> which has resulted in the highest mortality rate among nations with NCDs prevention measures.<sup>60</sup> As a result, these countries may reduce salt intake and, like other countries, meet their objective to reduce NCDs mortality by 2025 by designing and implementing effective interventions.

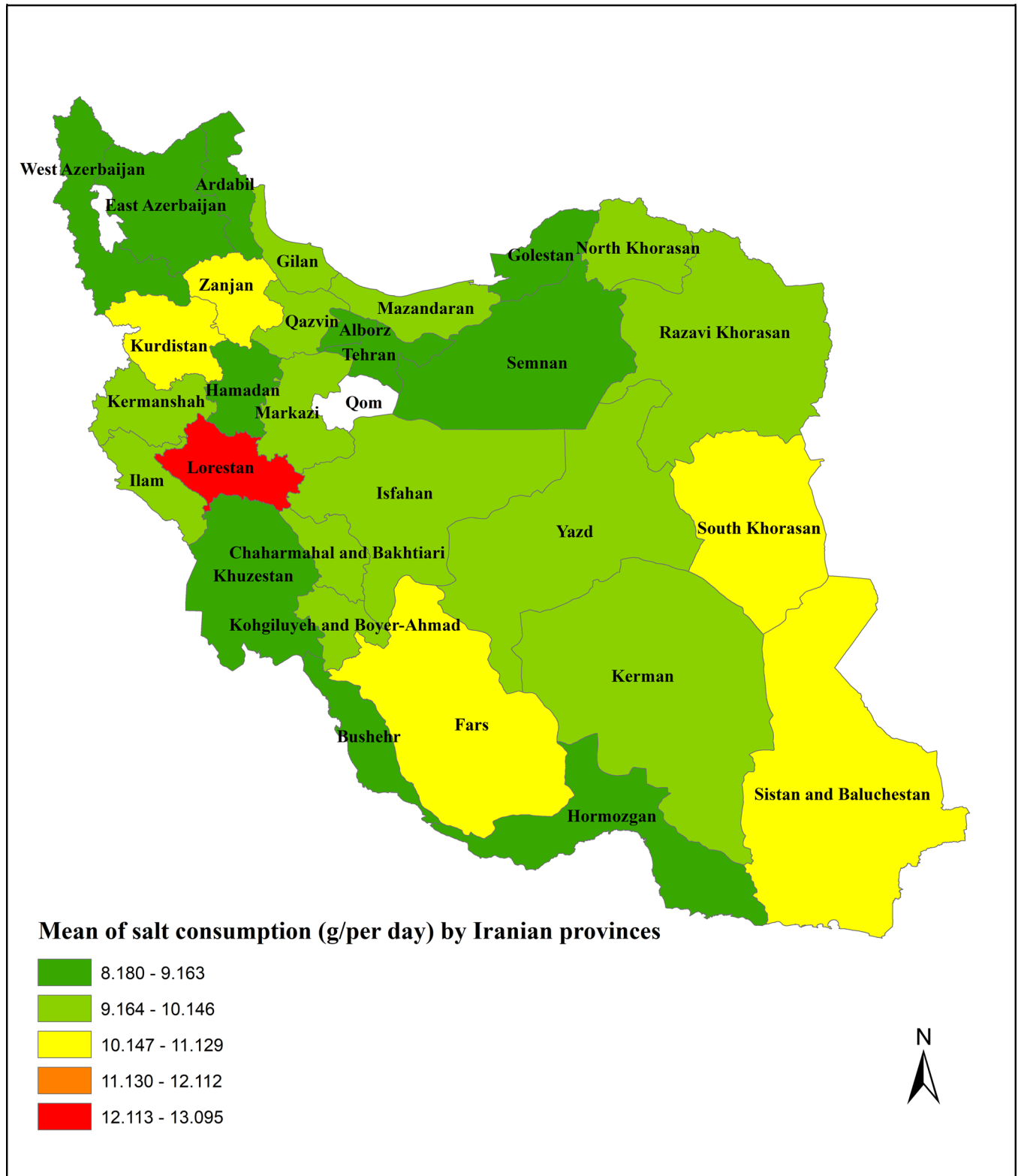
In this study, men's salt intake was assessed to be 10.393 g/day, greater than women's (9.517 g/day). A study similar to the current one compared men's (10.1 g/day) to women's (7.3 g/day) salt intake in Australia, as well as men's (9.61 g/day) and women's (6.61 g/day)

salt intake in India.<sup>54,55</sup> The mean salt intake of Japanese and Slovenian men was higher than that of women.<sup>25,61</sup> According to the Canadian Public Health Association, more than 85% of males and 60% consume too much salt.<sup>51</sup> Since most studies have found that men consume more salt than women, this mismatch can be explained by low-energy intake in women and gender differences. Furthermore, Iranian women consume more salt than women in other countries. This difference is most likely due to increased fast foods, canned products, and bread.<sup>62</sup> It may be argued that strategies and interventions based on community needs are required to minimize salt intake in Iran.

The mean salt intake in children was reported to be 5.66 g/day in this study; a study in Australian children assessed salt intake to be higher than 5.9 g/day.<sup>63</sup> In children, a maximum intake of 4.75 g/day (from <500 to <1900 mg/day) is recommended.<sup>64</sup> The significant amount of salt in children's meals is one of the causes behind their high-salt consumption.<sup>39</sup> However, lowering salt intake is recognized as a national health priority in Iran and is recommended by the WHO.<sup>14,65</sup> Health authorities should evaluate the quantity of salt consumed by children as a priority for individual and public health.

In this study, rural adults consumed more salt than urban adults, which could be attributed to the inclusion of salt in rural meals, particularly among men, and a lack of information about the association between excessive salt intake and related diseases, particularly hypertension.<sup>66</sup> Furthermore, our estimations reveal that salt intake is high in our provinces and varies by province. One possible explanation is that the individuals in these regions have varying dietary patterns and food diversity due to Iran's wide size and diverse population groupings.<sup>42</sup> Therefore, planning and identifying alternate approaches for improving the community's food pattern can be advantageous, depending on the intake pattern in each region.

Estimating the range of variances in the amount of salt consumed in the studies, on the other hand, was predictable due to using different measuring methods. As previously stated, the amount of 9.4 (7.26–12.54) g/day is still more than the maximum amount



**FIGURE 3** Mean salt intake (g/day) in provinces of Iran

recommended by WHO. The study's findings are diverse, which is unsurprising considering the diversity of the samples, the techniques used to determine the amount of salt consumed, and the study designs. As a result, multiple measures are necessary, including

monitoring the population's salt intake, identifying the key sources of salt in the diet, and developing successful salt-reduction initiatives.

Since 2009, the Ministry of Health and its affiliates have reduced population salt intake through various strategies, including product

labeling and restrictions on certain goods, such as bread.<sup>67</sup> However, the effectiveness of these strategies is unknown, as population salt intake has not yet been reduced. Although salt intake has decreased over time, a review of the periodic study examining salt intake in a large sample of the Iranian population in 2016 showed that salt intake has remained constant.<sup>42</sup> Furthermore, the results of another study conducted in the same population over time reveal no decrease in salt consumption.<sup>36</sup> Several countries such as the United Kingdom, Finland, and Japan have lowered general population salt intake through public education, partnership with the food sector, novel salt formulations in foods, and executive rules.<sup>7</sup> The Japanese government began a sustained effort in the 1960s to reduce the mean salt intake from 13.5 to 10.6 g by 2010. Various interventions may be employed to reduce salt levels and achieve the desired results, including education, social involvement, mobile applications, advertising, alternative use, and tax increases. However, due to the small number of samples and lack of repetition in the same sample in all studies, the analysis of the available data cannot reveal the change in the quantity of salt consumed by the population over time.

According to the WHO, one of the most effective ways to reduce salt intake is to organize public campaigns and interventions aimed at increasing recipients' knowledge and assisting them in making healthy food choices, gradually reducing salt in factory food products, and increasing easy and cost-effective access to healthy foods.<sup>68</sup> However, implementing health programs without proper planning and knowledge might waste resources.<sup>69</sup> As a result, research can be conducted to discover barriers and facilitators, predispose to change programs and increase effectiveness, and advocate for the adoption of salt reduction legislation.<sup>70</sup> Although lowering society's salt intake is challenging, multiple measures can achieve a 30% decrease in mean salt intake by 2025 and reduce NCDs mortality in Iran.

A common limitation among the selected studies was the inconsistent methodology they followed to ascertain sodium consumption, that is, some relied on 24 h urine samples. In contrast, others used spot samples, and others used Food Frequency Questionnaire for data collection. For this, we brought the results separately for each of the data collection methods. Additionally, they relied on differential equations to compute 24 h sodium consumption. Furthermore, the included studies did not study proportionate samples by age, gender, and living area (urban/rural), which should be considered when interpreting the current study results.

However, to have comparable results across the country, we suggest that related organizations (e.g., WHO or cardiology associations) should update standard guidelines for researchers who want to estimate sodium intake in the world.

## 5 | CONCLUSION

According to this review, the Iranian population consumes salt over twice more than amount recommended by WHO. Based on the evidence of salt consumption, WHO recommends that all countries implement a salt reduction program on the basis of the evidence

linking salt and CVDs. Iran, like many other countries, is working in this regard. It is evident that to reduce salt consumption, measures must be taken which take into account the sources of salt intake and the unique characteristics of each place. Individuals must also be educated on how to moderate their regular salt consumption. As a result, it is critical to investigate effective ways for reducing salt intake and to implement various strategies effectively; consequently, numerous heart attacks, strokes and other blood pressure-related diseases could be avoided.

## AUTHOR CONTRIBUTIONS

**Sirous Pourkhajoei:** Conceptualization; data curation; formal analysis; investigation; methodology; software; validation; visualization; writing – original draft; writing – review and editing. **Vahid Yazdi-Feyzabadi:** Conceptualization; data curation; investigation; methodology; software; validation; visualization; writing – review and editing. **Mohammadreza Amiresmaeili:** Conceptualization; data curation; investigation; methodology; supervision; validation; visualization; writing – review and editing. **Nouzar Nakhaee:** Conceptualization; data curation; investigation; methodology; validation; visualization; writing – review and editing. **Reza Goudarzi:** Conceptualization; data curation; formal analysis; investigation; methodology; supervision; software; validation; visualization; writing – original draft; writing – review and editing.

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No. 98001171 was approved by ethical committee of Kerman University of Medical Sciences. The Ethic approval Code is IR.KMU.REC.1399.294.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data are available upon request to the corresponding author after signing appropriate documents in line with ethical application and the decision of the Ethics Committee.

## TRANSPARENCY STATEMENT

The lead author (Reza Goudarzi) affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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APPENDIX A

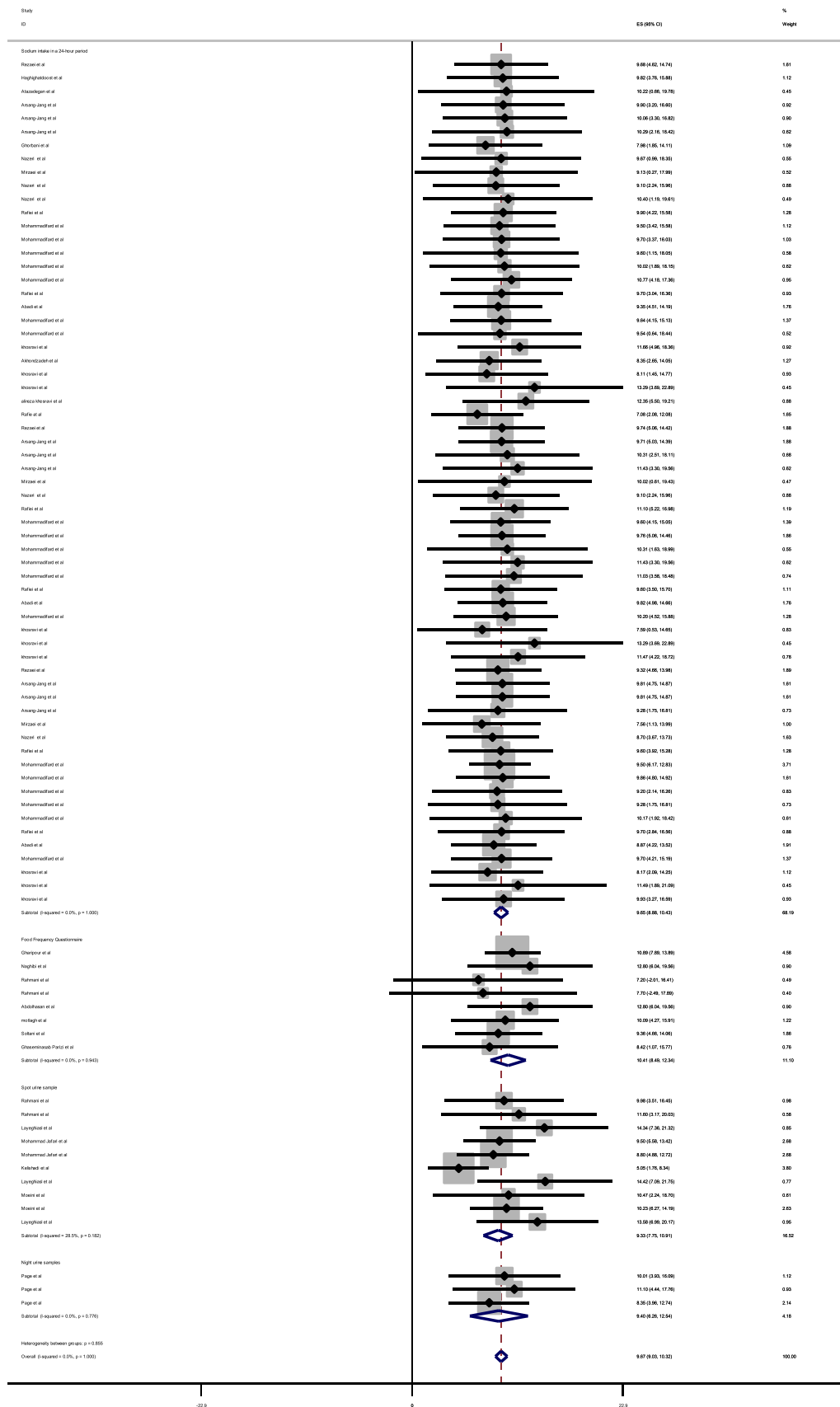


FIGURE A1 Summary of fixed-effects meta-analysis of salt intake, Iran, by measurement method

APPENDIX B

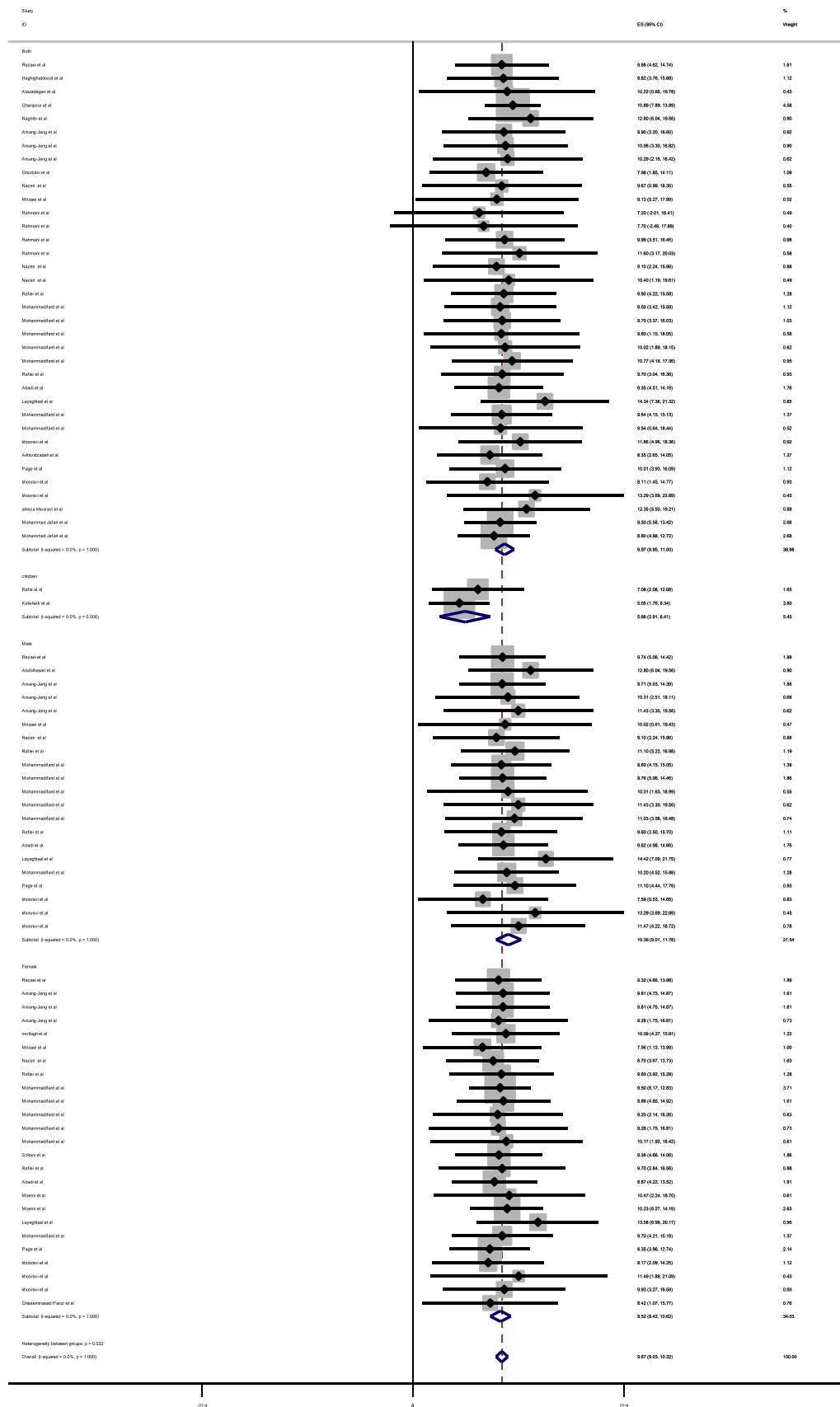


FIGURE B1 Summary of fixed-effects meta-analysis of salt intake, Iran, sex