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POLICY BRIEF

Protecting Sistan's Rural Older Adults: Policy Solutions for Energy-Driven Health Risks during Heatwaves

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ABSTRACT

Introduction: Climate change and energy poverty threaten health and healthcare access among rural older adults in Sistan, Iran, a region characterized by extreme heat, dust storms, and limited infrastructure. This policy brief synthesizes evidence from a qualitative study on the intersection of energy poverty, heatwaves, and healthcare access.

Materials and Methods: This policy brief is derived from an interpretive phenomenological qualitative study conducted in rural Sistan, Iran, between May and July 2026. Thirty-eight rural older adults aged 60–81 years participated in in-depth, semi-structured, face-to-face interviews lasting 45–90 minutes. Purposive maximum-variation and snowball sampling were used. Interviews were transcribed verbatim and analyzed using Interpretive Phenomenological Analysis (IPA) as the primary analytical approach, supported by thematic organization and constant comparison. Trustworthiness was ensured using Lincoln and Guba's criteria. Findings were translated into policy recommendations through a systematic evidence-to-policy process involving theme mapping, policy option identification, prioritization, and member checking.

Results: Six themes emerged: 1) inefficient energy subsidies; 2) weak electricity infrastructure and equipment damage; 3) geographic barriers and prohibitive healthcare costs; 4) perceived absence of a responsive monitoring and feedback system; 5) poor inter-sectoral coordination; and 6) inadequate training and capacity building. Participants reported high monthly electricity bills, daily power outages lasting approximately 2–3 hours, voltage fluctuations damaging oxygen concentrators and refrigerators, costly repairs of medical equipment, long distances to health facilities, and prohibitive healthcare visit costs. These conditions created a healthcare–energy trade-off and a spatial-energy trap.

Conclusion: Energy poverty and extreme heat jointly produce compound climate vulnerability among rural older adults in Sistan. Priority policy actions include targeted, tiered electricity subsidies (exact thresholds to be determined by economic evaluation), home-based care and telehealth, integrated monitoring and evaluation with community feedback, voltage stabilization and compensation funds, accredited training and heat warning systems, and a joint inter-sectoral task force. These measures should be implemented through short-, medium-, and long-term phases to protect health and improve healthcare access.

Keywords: Climate Change; Energy poverty; Healthcare Access; Heat Waves; Rural Older Adults; Sistan; Iran

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Introduction

Globally, climate change is recognized as a major threat to population health, with rising temperatures and extreme weather events disproportionately affecting vulnerable groups, particularly older adults and populations in geographically marginalized settings (1, 2). Iran, due to its geographical characteristics, is highly vulnerable to climate change, experiencing increasing temperatures, prolonged droughts, and frequent dust storms (3). The Sistan region in southeastern Iran ranks among the lowest in human development and healthcare access indicators, with geographic dispersion and long travel distances further exacerbating barriers to care (4–7). Heatwaves and persistent “120-day winds” create severe dust storms, disproportionately affecting older adults due to age-related thermoregulatory impairments and the high prevalence of chronic diseases (8, 9).

These climate-related risks are compounded by energy poverty, defined as inadequate access to reliable and affordable energy, which intensifies physiological stress during heatwaves, compromises the storage of temperature-sensitive medications, and disrupts electrically dependent medical devices (10). Energy poverty forces households into a "healthcare–energy trade-off," compelling them to forgo prescription medications or delay necessary healthcare in order to pay energy bills (11). While heat exposure and energy poverty have been studied separately, their intersecting effects on rural older adults' healthcare access remain underexplored in the literature. This intersection can be understood as a form of compound vulnerability, in which heat exposure and energy poverty interact to produce health risks that exceed the sum of their individual effects (12).

Conceptual Framework

To clarify the interrelationships among the key variables, a heuristic framework is proposed (Figure 1). This framework illustrates that climate change (specifically heatwaves) and energy poverty (manifested as unreliable electricity and unaffordable costs) jointly influence healthcare access through three influencing pathways: (a) direct physiological effects (heat-related illnesses), (b) indirect effects (damage to medical equipment and medication spoilage), and (c) economic constraints (household trade-offs between energy and healthcare expenditures). These pathways are further shaped by geographic isolation and infrastructural weaknesses, which intensify the overall vulnerability of rural older adults. This framework is heuristic rather than statistical; it organizes the qualitative findings and does not test mediating or moderating relationships.

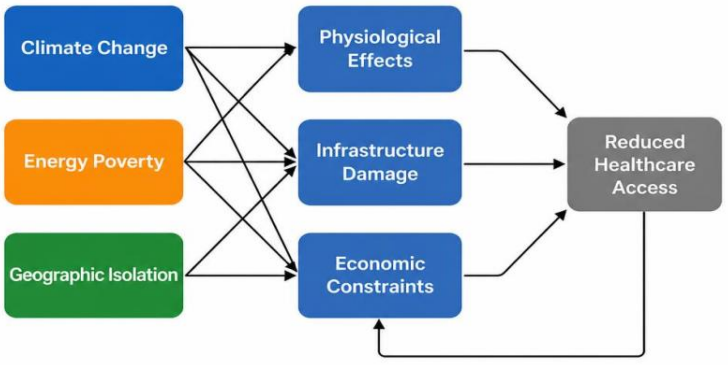


Figure 1. Heuristic framework of compound climate vulnerability: pathways linking climate change, energy poverty, and geographic isolation to reduced healthcare access among rural older adults in Sistan.

Knowledge Gap and Study Objective

Despite the growing body of evidence on climate change and energy poverty separately, the concurrent examination and interaction of these phenomena have received less attention in the research literature, particularly among rural older

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adult populations in climate-vulnerable regions such as Sistan. This gap is particularly significant given the convergence of extreme climatic conditions, chronic energy poverty, and a rapidly aging population in this region—a convergence that mirrors broader patterns documented among older adults facing heat and energy insecurity globally (13). Evaluating the lived experiences of affected populations is essential for generating evidence to inform climate-responsive and equity-oriented health policy.

The primary objective of this policy brief is to synthesize evidence from a qualitative study investigating the intersection of energy poverty and heatwaves among rural older adults in Sistan, and to provide actionable recommendations for policymakers in the health, energy, and social welfare sectors.

Materials and Methods

This policy brief is derived from a qualitative study employing an interpretive phenomenological approach to explore the lived experiences of rural older adults regarding energy poverty, heatwaves, and healthcare access. The study was conducted in Sistan, Iran, between May and July 2026.

Setting and Sampling: The study was conducted in rural areas of Zabol County, Sistan region, southeastern Iran. Sampling took place in 13 villages across Zabol County. Villages were purposively selected to maximize variation in distance to health facilities, electricity reliability, and heat exposure. Participants were recruited through local health houses and snowball sampling. A total of 38 in-depth, semi-structured, face-to-face interviews were conducted with rural older adults aged 60–81 years. Each interview lasted 45–90 minutes. Purposive sampling with maximum variation, combined with snowball sampling, was used to capture diverse perspectives across age, gender, marital status, education, occupation, household composition, housing status, and access to cooling equipment. Inclusion criteria were: (1) age ≥ 60 years; (2) residence in rural Sistan for at least five years; (3) lived experience of energy poverty and heatwaves; (4) willingness to participate; and (5) absence of severe cognitive impairment. Recruitment continued until data saturation was achieved; in total, 38 older adults from these 13 villages participated.

Data Analysis: Interpretive Phenomenological Analysis (IPA) was the primary analytical approach, supported by thematic organization for structuring codes into themes and sub-themes and constant comparison as an auxiliary strategy to identify patterns across interviews. Interviews were transcribed verbatim in Persian. Two researchers independently coded the first five transcripts; discrepancies were resolved through discussion. After consensus on the initial coding framework, one researcher coded the remaining transcripts, and the second researcher reviewed a 20% sample to ensure coding consistency. Codes were organized into themes and sub-themes using MAXQDA 2022 (VERBI Software, Berlin, Germany). Quotes were translated from Persian to English by a bilingual member of the research team and back-translated by an independent translator; discrepancies were resolved through discussion.

From Evidence to Policy Recommendations: To translate qualitative findings into actionable policy recommendations, the research team employed a four-step systematic process informed by the Evidence-to-Decision (EtD) framework (14). The four steps were: (1) extracting key implementation challenges from thematic analysis; (2) mapping these challenges against existing policy gaps identified in the literature review; (3) identifying and appraising policy options against three criteria-(a) potential impact on reducing vulnerability, (b) feasibility of implementation, and (c) required resources; and (4) prioritizing recommendations through consensus-based team discussion. The research team scored each option on a 3-point scale (1 = low, 2 = moderate, 3 = high) for each criterion; scores were discussed until consensus was reached. The final recommendations were validated through member checkin with a subset of five participants, who confirmed that the recommendations addressed

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their primary concerns and were relevant to their lived experiences (15).

Trustworthiness: To ensure the rigor of the study, Lincoln and Guba's criteria were applied (16): (1) credibility was established through member checking and peer debriefing; (2) transferability was supported by thick descriptions of the context and participants; (3) dependability was ensured through an audit trail documenting all research decisions; and (4) confirmability was achieved through reflexive journaling and bracketing.

Reflexivity: The research team acknowledged that their professional backgrounds (nursing, pharmacy, and health management) and institutional affiliations could influence data interpretation. To minimize potential biases, the following strategies were employed: (a) reflexive journaling was maintained by all researchers throughout the study to document assumptions and positional influences; (b) bracketing was practiced during interviews and analysis to suspend preconceptions; (c) peer debriefing sessions were held regularly to challenge interpretations and ensure that findings remained grounded in participant narratives; and (d) negative case analysis was conducted to identify and explore instances that did not fit emerging themes, thereby enhancing the credibility of the findings.

Key Implementation Challenges and Policy Gaps

This section presents the key implementation challenges identified through thematic analysis of the interview data. Each challenge is presented as an emerging theme with supporting participant quotes (coded excerpts), followed by policy implications derived from the research team's interpretation. Figure 2 provides a visual mapping of themes to policy recommendations.

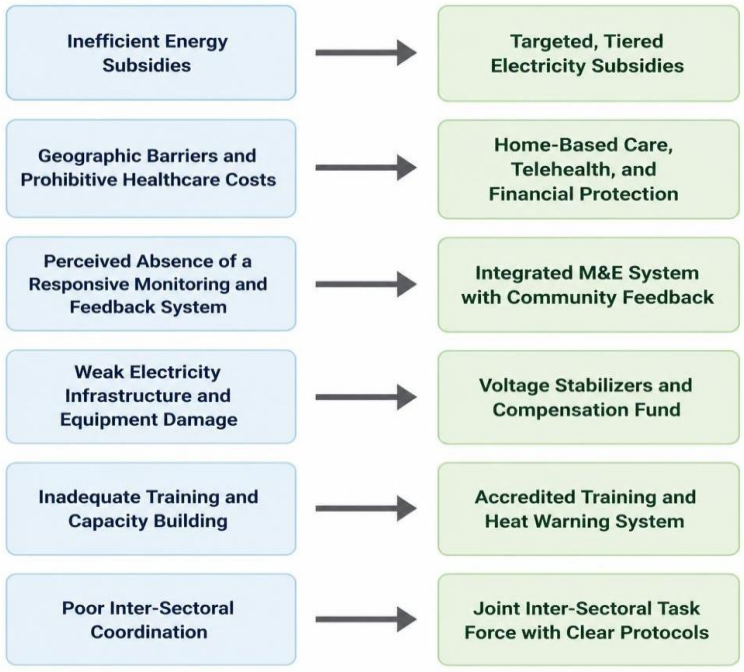


Figure 2. Conceptual diagram showing six themes from the qualitative study connected to six corresponding policy recommendations.

All themes presented in this section are derived exclusively from data collected through in-depth interviews with rural older adults (n = 38). Each theme is directly linked to specific sub-themes from the original qualitative study to ensure full auditability and transparency of the analytical pathway.

Theme 1: Inefficient Energy Subsidies

Emerging Theme (from participant narratives)

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Participants consistently reported that the existing electricity subsidy system, despite Sistan's classification as a hot climate region, does not adequately reduce energy costs for low-income households.

Supporting Evidence (coded excerpts)

- Participants reported that monthly electricity bills were unaffordable, and participants described selling productive assets to cover energy costs.
- One participant stated: "The subsidy doesn't help us; we still have to choose between paying the bill or buying food." (P12, Female, 67 years)

Connection to Qualitative Data

This theme was derived from sub-themes 1.2 (Unaffordable Electricity Bills) and 5.2 (Financial Resource Mobilization) of the original qualitative study, where participants consistently described the inadequacy of subsidies and the resulting financial trade-offs.

Policy Implications (research team interpretation)

The current subsidy structure fails to protect the most vulnerable populations. Moreover, there is a need for tiered, performance-based subsidy mechanisms to ensure equitable and effective support. Exact thresholds require formal budget-impact and affordability analyses.

Theme 2: Weak Electricity Infrastructure and Equipment Damage

Emerging Theme (from participant narratives)

Participants reported frequent and severe voltage fluctuations, as well as daily power outages lasting approximately 2–3 hours (as reported by participants), which damage household appliances and medical equipment.

Supporting Evidence (coded excerpts)

- Participants reported that damaged items included refrigerators, coolers, televisions, mobile phones, and oxygen concentrators.
- Participants reported that repair costs for damaged medical equipment (e.g., oxygen concentrators) were prohibitive and often required borrowing money.
- Participants reported that temperature-sensitive medications were compromised due to lack of reliable refrigeration.
- One participant explained: "My oxygen machine stopped working twice this summer. Each time, I had to borrow money to fix it." (P24, Male, 73 years)

Connection to Qualitative Data

This theme was derived from sub-themes 1.3 (Frequent Power Outages) and 1.4 (Voltage Fluctuations and Equipment Damage) of the original qualitative study, where participants described the direct consequences of unreliable electricity infrastructure.

Policy Implications (research team interpretation)

- Unreliable electricity combined with extreme heat creates a "cooling trap" where conventional coping mechanisms are systematically blocked.
- Infrastructure investment and rapid compensation mechanisms are urgently needed.

Theme 3: Geographic Barriers and Prohibitive Healthcare Costs

Emerging Theme (from participant narratives)

Participants described significant physical and financial barriers to accessing healthcare services.

Supporting Evidence (coded excerpts)

- Participants reported that the nearest health house (without a physician) is 14 kilometers away, and specialist hospital care is located 35–50 kilometers from rural villages.
- Participants reported that transport and consultation costs for a single visit were prohibitively high.
- Participants reported that ambulance response times were delayed up to 3 hours during heatwaves.

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- A participant noted: "Going to the hospital costs more than a month of electricity. We only go when we have no choice." (P8, Female, 71 years)

Connection to Qualitative Data

This theme was derived from sub-themes 4.1 (Geographic Distance and Travel Constraints) and 4.2 (Financial Costs) of the original qualitative study, where participants described the combined physical and economic burdens of accessing care.

Policy Implications (research team interpretation)

- Geographic isolation creates a "spatial–energy trap" that compounds healthcare access challenges. Home-based care, telehealth, and improved emergency response systems are also needed.

Theme 4: Perceived Absence of a Responsive Monitoring and Feedback System

Emerging Theme (from participant narratives)

Participants reported that, from their perspective, health facilities recorded some information but provided no feedback or visible follow-up. They described the monitoring system as non-responsive to their needs. This finding reflects perceived gaps in monitoring and feedback, not an independent audit of the national or local M&E system.

Supporting Evidence (coded excerpts)

- Participants described that, from their perspective, no continuous registration system exists for power outages, voltage fluctuations, medication spoilage, or heat-related hospitalizations that affect them.
- Participants reported that health facilities collect basic data, but they were unaware of any use of this information for improvement.
- One participant stated: *"They record some things at the health house, but we never hear anything about it. Nothing changes."* (P18, Male, 72 years)

Connection to Qualitative Data

This theme was derived from sub-theme **4.3 (Service Limitations)** of the original qualitative study, where participants described their observations of health facility operations and the lack of feedback or improvement based on reported issues.

Policy Implications (research team interpretation)

- Inability to identify critical points and assess intervention effectiveness hinders evidence-based improvements. Therefore, an integrated monitoring system with mandatory reporting and a community feedback loop is required.

Theme 5: Poor Inter-Sectoral Coordination

Emerging Theme (from participant narratives)

Participants consistently described weak coordination among relevant organizations as a major barrier to receiving integrated services.

Supporting Evidence (coded excerpts)

- Participants reported limited coordination between the Ministry of Energy, Ministry of Health, Planning and Budget Organization, and National Disaster Management Organization in delivering services to rural older adults. They also described the absence of clear protocols, flowcharts, or standardized guidelines for referral and follow-up. Moreover, participants noted low engagement from families and communities in supporting vulnerable older adults during heatwaves.
- One participant stated: *"Each organization does its own work. No one coordinates or plans together. We are left alone."* (P33, Female, 69 years)

Connection to Qualitative Data

This theme was derived from sub-theme **4.3 (Service Limitations)** of the original qualitative study, where participants described fragmented service delivery and lack of coordination among service providers, as experienced from their perspective as service recipients.

Policy Implications (research team

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interpretation)

- Ambiguity in responsibilities and lack of inter-organizational protocols undermine effective response; a joint task force with clear protocols is needed to address the heat and energy poverty crisis.

Theme 6: Inadequate Training and Capacity Building

Emerging Theme (from participant narratives)

Community health workers (**behvarz, the Iranian primary healthcare cadre**) and healthcare staff, as reported by participants, lacked sufficient training in heatstroke management and related areas.

Supporting Evidence (coded excerpts)

- Participants reported that health workers lacked adequate training in medication storage during power outages and identification of warning signs in older adults; participants and their families lacked knowledge about non-electric cooling strategies.
- Participants also noted that trained **behvarz** were not always available or recognized.
- One participant stated: "*We don't know what to do when the heat is too much. No one has taught us*." (P31, Male, 78 years)

Connection to Qualitative Data

This theme was derived from sub-theme 4.3 (Service Limitations) of the original qualitative study, where participants described gaps in training and knowledge among health workers, as perceived by service recipients.

Policy Implications (research team interpretation)

- Capacity-building programs are needed to enhance awareness and improve early recognition of heat-related warning signs.
- Formal accredited training and heat warning systems should be implemented.

From Evidence to Policy: Translation Process

This section explains how the six identified themes were translated into actionable policy recommendations. The translation process followed the four-step systematic approach described in the Methods (14).

Step 1: Mapping Themes to Policy Gaps

For each theme, the research team identified the corresponding policy gap that the theme represented. For example, "Inefficient Energy Subsidies" was mapped to the policy gap of inadequate targeting of subsidies to vulnerable populations, while "Weak Electricity Infrastructure" was mapped to gaps in infrastructure investment and maintenance.

Step 2: Identifying and Appraising Policy Options

For each policy gap, the research team identified multiple potential policy options based on international evidence and best practices. These options were evaluated against three criteria: (a) potential impact on reducing vulnerability, (b) feasibility of implementation in the Sistan context, and (c) required resources. The research team scored each option on a 3-point scale (1 = low, 2 = moderate, 3 = high) and discussed scores until consensus was reached. The selected option for each theme is presented in Table 2; alternative options are available from the corresponding author upon request.

Step 3: Prioritization

The following priority-setting matrix summarizes how each recommendation was prioritized (Table 1). Impact and cost ratings are consensus-based team judgments informed by international evidence, not formal cost analyses.

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Table 1. Priority-Setting Matrix: Mapping Recommendations to Implementation Timeline and Impact

Priority	Recommendation	Rationale
High (Short-term)	1. Tiered, targeted electricity subsidies	High potential impact; low-to-moderate cost (team judgment); feasible with existing billing systems. Exact targeting thresholds require budget-impact analysis.
High (Short-term)	2. Home-based care, telehealth, and financial protection	High impact; moderate cost (team judgment); can build on existing rural health infrastructure.
Medium (Medium-term)	3. Integrated M&E system with mandatory reporting and community feedback	Moderate impact; moderate cost (team judgment); requires information system and capacity.
Medium (Medium-term)	4. Voltage stabilizers and compensation fund	High impact but high cost (team judgment); requires inter-ministerial cooperation.
Medium (Medium-term)	5. Accredited training and heat warning system	Moderate impact; moderate cost (team judgment); requires curriculum and SMS platform.
Long-term	6. Joint inter-sectoral task force with clear protocols	High impact; requires political will and legal framework.

The final recommendations were validated through member checking with a subset of five participants, who confirmed that the recommendations addressed their primary concerns and were relevant to their lived experiences (15).

Policy Recommendations

Table 2 provides an overview of the actionable policy recommendations addressing the identified implementation gaps. The recommendations are presented in priority order, which corresponds to the order of themes in Table 2 (Priority 1–6). To avoid confusion, the themes in the Results section (Section 3) are also labeled with their corresponding priority numbers. Table 2 is divided into two panels for readability: Panel A presents challenges and recommendations; Panel B presents implementation considerations.

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Table 2. Proposed Policy Framework: Addressing Challenges in Energy Poverty and Healthcare Access among Rural Older Adults in Sistan

Panel A. Challenges and Recommendations

Priority	Key challenge	Actionable policy recommendation	Policy objective
1 (High)	Inefficient energy subsidies	Replace token subsidies with targeted, tiered electricity subsidies based on verified income and health vulnerability; include special provisions for older adults with chronic disease/device dependence. Exact thresholds to be determined by budget-impact and affordability analysis.	Reduce financial burden and prevent asset depletion.
2 (High)	Geographic barriers and prohibitive healthcare costs	Deploy home-based care during hot days; establish medication storage hubs with backup power; expand telehealth; expand financial protection through subsidized premiums/exemptions and reduced co-payments, rather than blanket free insurance.	Reduce travel and out-of-pocket costs.
3 (Medium)	Perceived absence of a responsive monitoring and feedback system	Establish an integrated M&E system with mandatory reporting of outages, voltage fluctuations, medication spoilage, and heat-related hospitalizations; include a community feedback loop.	Improve accountability and data-driven improvement.
4 (Medium)	Weak electricity infrastructure and equipment damage	Install voltage stabilizers; establish a compensation fund with rapid payment; prioritize uninterrupted power for households with device-dependent patients.	Prevent equipment damage and medication spoilage.
5 (Medium)	Inadequate training and capacity building	Design accredited training for community health workers (behvarz); public education on non-electric cooling; launch heat warning system via SMS and automatic calls.	Increase capacity and improve early recognition of heat-related warning signs.
6 (Long-term)	Poor inter-sectoral coordination	Form a joint task force among Ministry of Energy, Ministry of Health, Planning and Budget Organization, and National Disaster Management Organization; develop clear referral and follow-up protocols.	Create integrated response and prevent duplication.

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Panel B. Implementation Considerations

Priority	Qualitative evidence from study	Potential outcomes (to be evaluated)	Hurdles	Suggested solutions
1	Participants reported bills they perceived as unaffordable, selling productive assets, and choosing between energy and food/healthcare.	May reduce energy poverty and free resources for healthcare; subject to evaluation.	Budget allocation; revision of budget law; targeting accuracy.	Pilot in high-risk villages; phased implementation; independent evaluation.
2	Participants reported long distances, high transport/consultation costs, and delayed ambulance response.	May reduce emergency visits and improve timely access; subject to evaluation.	Human resources; intersectoral coordination; fiscal sustainability.	Train behvarz as telehealth facilitators; partner with NGOs; use existing rural health infrastructure; pilot financial protection.
3	Participants reported data were recorded but no feedback or change was observed.	May improve transparency and responsiveness; subject to evaluation.	Staff time; training; information systems.	Integrate M&E indicators into existing health information systems (e.g., SIB/Sina); use mobile data collection; establish a community feedback channel via behvarz.
4	Participants reported voltage fluctuations damaging oxygen concentrators, refrigerators, and coolers; costly repairs; medication spoilage.	May reduce equipment damage, medication spoilage, and hospitalizations; subject to evaluation.	High infrastructure costs; inter-ministerial cooperation.	Prioritize high-risk villages; seek climate adaptation funding; public-private partnerships.
5	Participants reported insufficient training, lack of knowledge, and lack of recognition for trained workers.	May increase awareness and community resilience; subject to evaluation.	Training costs; staff time.	Integrate into existing curricula; mobile-based training; academic partnership.
6	Participants perceived fragmented services and lack of coordination. This reflects service-user experience, not independent verification of national structure.	May improve coordination and resource efficiency; subject to evaluation.	Political will; legal protocols.	Start with high-level ministerial agreement; technical working group; build on existing disaster management mechanisms.

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Discussion

This policy brief provides insight into the lived experiences of rural older adults in Sistan facing the intersection of energy poverty and extreme heatwaves. The findings reveal compound climate vulnerability where inadequate electricity, frequent outages, voltage fluctuations, insufficient subsidies, and extreme temperatures converge to create life-threatening conditions that undermine health and healthcare access.

The findings demonstrate that energy poverty functions as a structural determinant of health through multiple reinforcing pathways: direct physical effects of heat exposure, medication storage failures, chronic disease exacerbation, psychological distress, and financial trade-offs displacing healthcare spending. This aligns with Hernández's conceptualization of "energy insecurity" as a multi-dimensional construct encompassing economic, physical, and behavioral dimensions - defined as an inability to adequately meet basic household energy needs, with adverse health and social consequences (17). This definition captures the uncertainty about energy availability, affordability, and potential damage that participants described.

Similar patterns have been documented globally. Research in rural Puerto Rico found energy insecurity exacerbated health vulnerabilities by disrupting medical equipment and medication refrigeration (18). Moreover, a study from Ghana demonstrated that energy poverty significantly increases the probability of illness while reducing the likelihood of healthcare consultation (19). Research from rural China has also shown that energy poverty is associated with reduced efficiency of primary health services (20), while European comparative evidence indicates higher rates of poor physical and mental health among energy-poor populations (21).

The prevalence of voltage fluctuations causing equipment damage, with high replacement costs, aligns with Rodgers and O'Neill's concept of "infrastructural violence" - systematic harm produced by unreliable infrastructure (22) - while Farmer et al.'s "structural violence" provides a broader frame for understanding how social structures constrain agency (23). The combination of extreme heat, dust storms, and unreliable electricity creates a "cooling trap" where all conventional coping mechanisms are systematically blocked. This climatic feature of Sistan creates a unique barrier to cooling that has not been documented in other heat-prone regions, where outdoor sleeping is typically a viable coping strategy (24, 25).

According to the findings, there is a "healthcare–energy trade-off" where energy costs compete with healthcare spending. This aligns with research from other low- and middle-income settings where households face similar trade-offs, including the concept of "systemic cooling poverty" as a form of intersecting deprivation (26). However, geographic isolation in Sistan creates a particularly severe "spatial–energy trap." Finally, prohibitive healthcare costs per hospital visit, combined with monthly electricity bills, make healthcare effectively inaccessible for many households.

Despite Sistan's classification as a hot climate region with special electricity subsidies, participants consistently reported that remaining costs were unaffordable for low-income households. This finding suggests current subsidy mechanisms, while well-intentioned, are insufficient to protect vulnerable populations from energy poverty. Summer energy poverty has been historically overlooked compared to winter energy poverty, yet it is a rapidly growing concern requiring targeted interventions. WHO and international frameworks emphasize integrating energy resilience into public health planning (27).

Strengths and Limitations

This study had several strengths: the use of in-depth qualitative methods that enabled rich exploration of participants' lived experiences, and the achievement of data saturation across a diverse sample of 38 participants. However, several limitations should be acknowledged: 1) the geographic focus on one county (Zabol) may limit transferability to other

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contexts; 2) the study relied on self-report and did not independently verify electricity consumption or health outcomes, which may introduce recall bias; 3) policymakers were not involved in the evidence-to-policy translation process, which may affect the feasibility assessment of recommendations; and 4) the gender composition and representativeness of the sample should be considered when interpreting the findings. Future research should explore these phenomena in other climate-vulnerable regions and employ mixed methods to quantify health impacts and evaluate the effectiveness of policy interventions. Table 2 presents policy options, not costed projections. Any thresholds or expected outcomes require formal budget-impact, affordability, and cost-effectiveness analyses before adoption. The numbers reported by participants are self-reported examples and are not generalizable.

Conclusion

Rural older adults in Sistan experience compound climate vulnerability where energy poverty and extreme heatwaves create life-threatening conditions that fundamentally undermine health and healthcare access. Frequent daily power outages (2–3 hours, as reported by participants), destructive voltage fluctuations, inadequate subsidies despite hot climate tariffs, temperature-sensitive medication failures, and healthcare-energy trade-offs force individuals into impossible choices between basic survival needs. Moreover, prohibitive healthcare costs per hospital visit make healthcare effectively inaccessible for many households. Energy poverty functions as a structural determinant of health through multiple reinforcing pathways, and geographic isolation creates a "spatial - energy trap" that compounds these challenges.

Based on these findings, the following prioritized policy recommendations are proposed, consistent with Table 2:

Short-term (Priority 1–2)

1. Implement targeted, tiered electricity subsidies based on verified income and health vulnerability, with special provisions for older adults with chronic disease/device dependence. Exact thresholds to be determined by formal budget-impact and affordability analyses.
2. Deploy home-based care services, medication storage hubs with backup power, telehealth services, and expand financial protection through subsidized premiums/exemptions and reduced co-payments for rural older adults.

Medium-term (Priority 3–5)

3. Establish an integrated monitoring and evaluation system with mandatory reporting and a community feedback loop.
4. Invest in voltage stabilization infrastructure and establish a compensation fund for damaged medical equipment.
5. Design and implement formal accredited training programs for community health workers and launch a heat warning system via SMS and automatic calls.

Long-term (Priority 6)

6. Form a joint task force among relevant ministries with clear protocols for crisis management.

Cross-sectoral governance mechanisms involving health, energy, and social welfare ministries are needed for integrated policy approaches.

Authors' Contributions

M.PM and P.I designed the research; M.PM and AB conducted the research; M.Sh analyzed the data; M.PM, A.B, M.Sh and P.I wrote the paper. P.I had primary responsibility for final content. All authors read and approved the final manuscript.

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Competing Interests

The authors declare no competing interests.

Data Availability Statement

The qualitative data are not publicly available due to confidentiality and ethical restrictions. De-

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identified data may be available from the corresponding author upon reasonable request and with approval from Zabol University of Medical Sciences.

Ethical Considerations

Ethical approval for this study was obtained from the Ethics Committee of Zabol University of Medical Sciences (IR.ZBMU.REC.1405.044) in April 2026. All procedures adhered to the Declaration of Helsinki. Written informed consent was obtained from all participants. For participants with limited literacy, consent was obtained orally in the presence of a witness, and this procedure was approved by the ethics committee. Anonymity was guaranteed using identification codes.

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Artificial Intelligence Use Disclosure Statement

The authors did not use AI for data analysis, interpretation, or figure generation. For language editing and improving readability, the authors used DeepSeek-R1 (DeepSeek AI, 2026). All AI-assisted content was reviewed, verified, and edited by the authors, who take full responsibility for the final manuscript.

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