

Affordability re-examined: beyond the health burden of safe water and clean cooking

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Clean fuels and safe water have a clear role in averting devastating health outcomes, yet unaffordability remains a major barrier to their uptake and to correct and continued use. Within the global health field, we have no consistent answer to the question of how we know that something is affordable and for whom. In this Viewpoint, we draw on the literature and our own fieldwork in Tanzania, Mexico, and India to show that commonly used metrics of affordability do not represent the true burdens of affording safe water and clean cooking in low-income and middle-income countries. We discuss the explicit and implicit assumptions in existing affordability metrics and call for augmented measures to shape affordability policies for water and cooking that advance global health goals. Research and policy must be realistic about who the user is, what the user's constraints are, and how these constraints shape any meaningful affordability metric. Unrealistic affordability metrics can only hide affordability crises and hinder progress on global public health goals.

Introduction

In this Viewpoint, we examine how global health research defines the affordability of consumer products that can protect against common diseases. The health and wellbeing of billions of individuals, particularly in low-income and middle-income countries (LMICs), depend on their ability to afford certain products.¹ Specifically, avoiding the more than 2 million annual deaths attributed to unsafe water and polluting energy^{2,3} hinges on asking consumers to pay an upfront cost for a safe-water device or stove and ongoing costs for water treatment or cooking fuels. However, within the global health field, we have no consistent answer to the question of how we know that safe water and clean cooking are affordable and for whom. Although the impact of unsafe water and polluting fuels has been well documented,^{4,5} as have interventions to provide safe water and clean fuel,^{6,7} household affordability remains an under-investigated, and thus poorly understood, dimension of clean water and clean cooking adoption. Behavioural economic approaches, for example mental accounting or expectations-based behaviours, have offered explanation of why users might not purchase health products even when nominally affordable.⁸ However, we argue that health policy and practice must first understand (1) how the global health sector defines what is or is not affordable, (2) that everyday health products (eg, food, medication, and bednets) could be more unaffordable than commonly realised, and (3) why this is so, before attempting to explain why so-called affordable products are not purchased in reality.

We contend that commonly used metrics of affordability do not represent the true burdens of affording safe water and clean cooking in LMICs. The metrics do not specify who is buying the product, what users must forgo to buy it, and what it realistically costs to use and maintain in terms of time and money. Understanding affordability from a user's perspective is necessary for the correct and continued use of safe water and clean cooking and for the achievement of improved health outcomes.

In this Viewpoint, we discuss the explicit and implicit assumptions in existing affordability metrics and call for augmented measures to shape affordability policies that meaningfully advance global health goals. We draw on the affordability of clean water and clean cooking fuel literatures and on our own fieldwork experiences in Tanzania, Mexico, and India. These reflections on affordability could also be relevant for other products (eg, food and medication) needed to advance household-level health.

Current affordability metrics for safe water and clean cooking

Affordability is the capacity to pay for a minimum level of service.⁹ In the clean cooking literature, however, affordability is frequently equated with the upfront price of the stove;¹⁰ the next most common metric is the cost per unit energy, time, meal, or capita,¹⁰ without relating that cost to capacity (ie, income or expenditure). The water sector has discussed more nuanced metrics of affordability, namely the conventional affordability ratio (CAR), less commonly, the potential affordability ratio (PAR),¹¹ and, rarely, the residual income approach ratio (RIAR). Various thresholds then determine an affordable level of service. Higher ratios indicate that a product is less affordable, claiming a larger percentage of an individual's income or expenditure.

The CAR is a ratio of a household's monthly expenditure on clean water (or fuel) to overall monthly income or expenditure. Any expenditure estimate could conceal potential over-consumption or under-consumption. For example, a household's expenditure on water could be within an acceptable threshold because it is mostly meeting its needs with unsafe water. There are only a few examples of researchers using the CAR for clean cooking fuel.^{12,13} Prominent international institutions have advocated maximum thresholds for the CAR, such as 5% for clean fuel¹⁴ and 3–5% for water and sanitation.¹⁵

The PAR is the ratio of the price of a minimum needed amount of water (or cooking fuel), such as 50 litres

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per person per day, or 2 megajoules-delivered per capita per day, divided by the household's total income or expenditure. It is difficult to establish minimum water and fuel for domestic needs, leading to arbitrary¹¹ thresholds that could promote under-consumption.

The RIAR is the ratio of a household's monthly expenditure on clean water (or fuel) to a household's monthly expenditure or income after subtracting out essential expenses such as rent, medicine, or food. This approach provides the clearest picture of the percentage of income actually available, but it is data intensive to assess. Furthermore, it demands, as many metrics do, judgements about what are essential services. The RIAR has not been applied in water policy, and only once to cooking energy research.¹⁶

Each of these affordability ratios provides a window into the financial burden of clean water and clean cooking but each embeds assumptions that shape what we consider affordable or unaffordable. Three common assumptions embedded in these metrics, related to time, labour, and household structure, make them incompatible with the lived experience of many low-income users.

Time and cost of safe water and clean cooking

Affordability ratios have historically been based on a monthly expenditure or income (the denominator) and a per-month price (the numerator). Estimation on a monthly timescale provides an inaccurate picture of the income situation when, as for many individuals in LMICs, incomes are irregular or seasonal. Day labourers do not earn every day. People with low income can have intricate financial portfolios with expenses and loans and even small savings, but they operate on daily or every-few-day timescales;¹⁷ this is particularly true for women who often earn smaller amounts and do not have access to more regular jobs.¹⁶ Individuals do try to smooth their consumption in the face of irregular incomes, but these efforts are thwarted by small (and seemingly inevitable) emergencies (eg, a sick child or a broken bicycle needed for transport to work). The CAR, PAR, and RIAR, even when based on recurring costs alone, might not match how users earn, spend, and control money.

Individuals often purchase water treatments (eg, liquid chlorine) or fuel (eg, charcoal) every few days when they have the money, or when the need is urgent. Monthly prices therefore mean very little to low-income users and their ability to afford water or fuel. Microcredit (access to small loans) could potentially help smooth cooking fuel consumption, but this approach has fallen short because the credit usually covers the stove and not the recurring fuel purchase.¹⁸ When durables, such as water infrastructure, filters, or a cookstove, are included in affordability measures, they are typically amortised into a levelised cost over the product's lifetime.¹⁰ For populations with low, volatile incomes and without financial tools (eg, access to credit or saving options), a monthly amortised

cost to be paid over 5 years has no meaning; it is more a number for policy discourse than for practical action because it does not reflect how users see their finances. Amortising costs on a weekly basis could better reflect how users might save towards or repay the capital cost.^{17,19}

Labour and the cost of safe water and clean cooking

All affordability metrics currently in use include only financial costs (ie, prices), ignoring the cost of household labour.^{14,20} The little research on the time burden of fetching shows that, within most households, it is mainly women and girls who expend time and effort in collecting water^{20,21} and fuel.^{22,23} They are responsible for in-home water treatment (if any), for learning how to cook with new stoves and fuels, and for maintaining filters and stoves.

Social norms are often such that women perform unpaid work as caretakers, water collectors, domestic managers and protectors, cooks and cleaners, and even trainers and educators for their communities.²⁴ Care work can be shared with children or older adults. These forms of donated female labour are taken for granted by communities, most health and economics researchers, donors, and policy makers, although ethnographic research has critiqued this unspoken norm.²⁵ When the labour embedded in clean energy and water is uncounted in money or time terms,^{11,14} affordability metrics and any policies built off them imply that women's work is not a cost. However, women's and girls' time has opportunity costs that must be rationed and allocated over multiple competing needs, exactly as money is.

Local market failures could be another type of unaccounted cost, as they can make products de facto unaffordable, as when chlorine or liquefied petroleum gas (LPG) stores are far away, or access is hampered by road or weather conditions.

Household structures and the cost of safe water and clean cooking

Beyond labour, existing affordability metrics ignore intra-household dynamics and the question of who bears the cost of water and energy improvements. The CAR, PAR, and RIAR are all based on the model of a unitary household that spends money or contributes income towards a joint need. Despite decades of research disavowing the unitary household model,^{26–28} the water and cooking literatures have never incorporated intra-household dynamics into affordability models.^{10,29,30}

Intra-household financial structures determine what the available income or denominator in affordability ratios should be and our understanding of how households afford items. Some cultural norms replicate the unitary model in financial decision making, in which everyone's incomes are pooled towards joint decisions, although decision-making power might not be equal. Working with water filters in India we found that women wanted the filter, but the husband's voice was the dictating factor: "We do need it [the water filter]. It is better; the

water looks better. But my husband doesn't want to give me the money" (Ahmednagar, India; Ray I, unpublished). In this case, the total family income is available as the denominator for the affordability ratio, although only one individual can act on their preferences. In more dire circumstances, the denominator can be so small that preferences are irrelevant. What is affordable reflects both power and priorities, and an acceptable affordability ratio is not a simple statement of ability to pay.

In other contexts, spouses might negotiate over buying household goods, mirroring the classic bargaining model.²⁶ We have met husbands whose wives influenced their LPG purchases: "Well, I do not want to spend the money. But I feel pressure. Let me see" (Bangalore, India).³¹ Other negotiations are more explicit. Our research project in rural Mexico³² offered subsidised household-level water disinfection systems, which men sometimes declined. More than once, however, the wife would seek a private conversation, and the couple would return with a different decision: "We agreed to make an effort" (Baja California Sur, Mexico).³² In both cases in India and Mexico, the total family income is the relevant denominator, but both individuals negotiate the purchase. Typical affordability ratios conceal intra-household bargaining power; equal affordability ratios hide very different realities of how users afford products.

In other cultural contexts, the joint household income is not an appropriate denominator at all. In our field site in rural Tanzania, women alone were responsible for purchases of LPG and all daily household needs.¹⁹ Households follow a tradition of separate spheres of spending²⁸ rather than explicitly bargaining behaviour.²⁶ "I would not accept that [my husband] would know my expenses" (Shirati, Tanzania), or, "My work is to buy the gas; his work is to buy the TV" (Shirati, Tanzania).¹⁹ Women in this area of Tanzania have near-total autonomy over the fuel, and their income (earnings, allowances, or both) is the relevant denominator as men are not expected to contribute to cooking fuel purchases.

Affordability metrics that use a unitary household as a default model ignore both the reality of bargaining (albeit with power asymmetries) models and of separate-spheres models. We need to know the prevailing household structure and financial norms (eg, what fraction of household income is usually available for daily domestic needs) before we calculate the denominator for supposedly affordable clean water or cooking fuel.

A call for new approaches to affordable water and cooking fuel

Failing to account for the timescales, labour costs, and intra-household dynamics could lead to persistent affordability mismeasures and therefore lagging progress on global health goals. Worse, researchers and policy makers might blame low-income users for neither purchasing nor seeming to value the so-called affordable product that is not, in fact, affordable.

We call for three new approaches to more fully understand the affordability burden of safe water and clean cooking. First, we support the RIAR for clean water and cooking. Affording water and energy cannot come at the cost of food or medication, or other core components of health. Consider a household of five individuals in rural Tanzania, with a weekly expenditure of US\$150 (in 2022 US\$) after adjusting for purchasing power parity. Almost 50% of that expenditure could be on food and medical expenses (per our fieldwork¹⁹ and previous anthropological literature¹⁶). Exclusive LPG use would require approximately \$13 per week, plus around \$130 for the initial burners and cylinders, unless these were free or subsidised. The CAR would indicate an affordability ratio of 8.6%, whereas the RIAR reveals a higher ratio of 17.3%, which indicates that clean cooking fuel is less affordable.

Second, we argue that for certain products—in the focus of this Viewpoint, safe water and clean cooking fuel—gender-specific metrics, estimated per week rather than month, could more appropriately reflect affordability. In the context of households in which the woman alone is responsible for domestic purchases, the conventional CAR and RIAR obscure a more dire affordability crisis. A gender-specific RIAR would

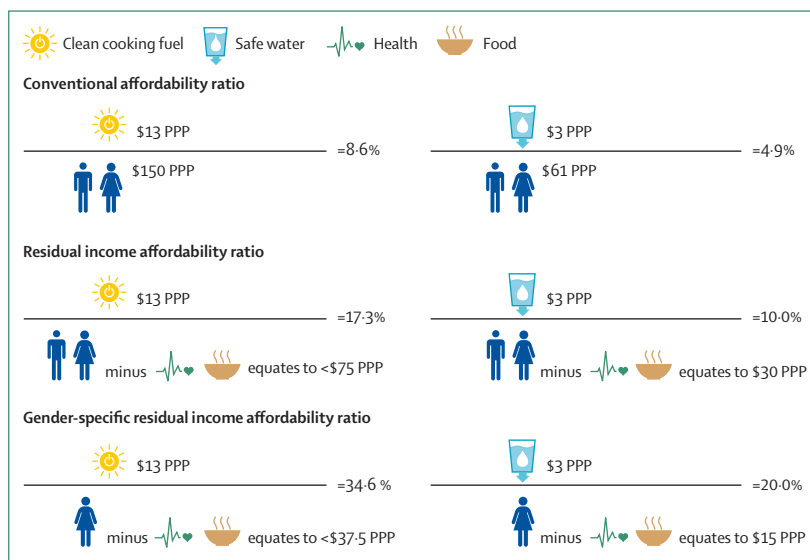


Figure: Field-based examples of affordability ratios for clean cooking fuel and safe water

Field-based examples of the conventional affordability, residual income, and gender-specific residual income affordability ratios for clean cooking fuel (left) and safe water (right). We compare three different approaches to measuring affordability of safe water and clean cooking fuels to evaluate how each suggest very different financial burdens depending on whether they account for other essential needs or intra-household dynamics. A gender-specific residual income affordability ratio reveals a more dire affordability crisis for safe water and clean cooking fuel than the conventional or residual income affordability ratio mask. Monetary values are in US\$. The numerators are the weekly cost of exclusive liquefied petroleum gas use from Shirati, Tanzania, in 2022, and the cost of chlorine for safe water in Katoma, Tanzania, in 2012–13, after adjusting for PPP. The denominators are the estimated average and median household income, respectively, in each field site; household income after essential purchases (health care and food); and the woman's income or allowance after essential purchases. We exclude upfront capital costs in both examples and use US\$ for the year of data collection. We use the Sustainable Development Goal (SDG) icons to represent safe water (SDG 6: clean water and sanitation), clean cooking fuel (SDG 7: affordable and clean energy), health (SDG 3: good health and wellbeing) and food (SDG 2: zero hunger). PPP=purchasing power parity.

increase the affordability ratio for cooking fuels to at least 35% (figure) because the woman manages only half the total household income. Affordability is not gender neutral because power, incomes, and time burdens are not gender neutral.^{24,25,19}

Third, we advocate for affordability discussions that acknowledge domestic (usually female) labour in safe water and clean cooking fuel procurement and management.^{20,19} Monetising household labour is controversial, but at least estimating the labour of water and energy (or any health product) can bring visibility to women's labour and credibility to cost measures from the household perspective. Such a step acknowledges that price is not cost.

Further research is needed on how these three new approaches can be measured and incorporated into realistic and tractable affordability metrics. The global health research community should reflect on why we want to understand and measure affordability. For global analysis, the unitary household model might be sufficient, but for context-appropriate analyses trying to understand whether users can afford, for example, clean water or energy, more realistic metrics could be worth the added effort. Our recommendations can be implemented if specific questions on time for water treatment and cooking, and on the income that contributes to these purchases, could be added to routine sample surveys that many countries periodically conduct. Researchers and policy makers could then use the relevant expenditure data after subtracting, for example, food and medication estimates. Depending on the context, the RIAR denominator could be gender-specific or not. Although households within communities are heterogeneous, it would be more practical to use the most prevalent intra-household financial structure in place-based health research. This future research could inform tailored policy or targeted subsidies (eg, for those below the median RIAR).

Finally, we call on policy makers to use these reflections to consider affordability, of clean cooking fuel, safe water, or any health product, from the users' perspective. The CAR is most often used for water and energy affordability thresholds,^{11,14} but can be a spurious number. There are several policy levers to increase safe water and clean fuel adoption and use, such as providing financial tools, extending supply chains, educational or behavioural campaigns, and subsidies. But research and policy must be realistic about who the user is, what the user's constraints are given their gender, income, power, or time burdens, and how these constraints shape any meaningful affordability ratio. Clean water and clean energy are the foundations of global health; policies to promote health cannot afford to over-simplify what is and is not affordable.

Contributors

AG-W and IR contributed equally to conceptualisation, data curation, and review and editing of the manuscript. AG-W was responsible for figure creation and writing of the original draft. All authors had final responsibility for the decision to submit for publication.

Declaration of interests

We declare no competing interests.

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