

## Article

# The Meanings of Water: Socio-Cultural Perceptions of Solar Disinfected (SODIS) Drinking Water in Bolivia and Implications for its Uptake

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**Abstract:** Solar disinfection (SODIS) of drinking water is a cost-effective household water treatment (HWT) method. Despite its simplicity of use, evidence suggest that SODIS water uptake remains lower than implementers planned. In this paper, we investigate socio-cultural factors associated with SODIS water uptake in rural Andean Bolivia. We conducted 28 semi-structured in-depth interviews and six focus group discussions within the framework of a community randomised trial to assess the uptake of SODIS water in the Bolivian Andes. Participants argued that SODIS does not produce an attractive type of drinking water despite acknowledging that SODIS represents a simple, safe, low-cost, and easy method of preparing safe drinking water. Attitudes towards SODIS water reflected local interpretations of water, health, and illness. The taste of SODIS water, the invisibility of water-borne pathogens, and habituation to untreated water represented the main barriers to SODIS water uptake. Alternative culturally adapted SODIS promotional campaigns (e.g., using herbs and additives to improve SODIS water taste) can increase its perceived desirability.

**Keywords:** cultural meanings; diarrhoea; SODIS; water and hygiene; BoliviaWET

## 1. Introduction

Solar disinfection (SODIS) of drinking water is an effective, low-cost, and practical household water treatment (HWT) method that provides easy access to safe drinking water. Raw water is exposed to full sunlight for at least six hours, and the joint effects of exposure to ultraviolet radiation and increased temperature inactivate pathogens in the water. The SODIS method has shown significant antimicrobial effects in laboratory [1] and experimental field tests [2–4] and is currently promoted in more than 50 African, Latin American, and Asian countries [4].

Despite its simplicity and wide dissemination, the uptake of SODIS is lower than implementers planned [5–7]. In 2011, less than 5% of households in developing countries used the SODIS method regularly [8]. In addition, various field studies and randomised controlled trials investigated the compliance with the SODIS HWT method in detail. A SODIS programme evaluation in 18 countries

showed that compliance rates ranged from 20% to 80% one year after implementation [5]. Research into the acceptance of the SODIS method in Nepal found a 9% routine SODIS water uptake [9] and, similarly, a SODIS water uptake of less than 6% was found in a three-year post-evaluation project in Guatemala [10]. A randomised controlled trial conducted in South Africa reported a decline in SODIS method use from 75% to less than 30% after week 40, and found hardly any participants to adopt the SODIS method one year after study end [11]. Similarly, a trial in rural Andean Peru found an initial 60% observed compliance with the SODIS method declining steadily over time. At the end of the one-year follow-up, the SODIS method was only practised by 10% of the intervention group. This percentage dropped to 6% one year after the conclusion of the study [12]. In another trial conducted in rural Bolivia, an average rate of daily SODIS method use of 32% was observed during a one-year observation period [13]. Similarly, a recent evaluation in Bangladesh found 34% of the study participants routinely practised the SODIS method. This proportion dropped to 4% two months after the study concluded [14]. In summary, evidence from various field trials show that compliance with the SODIS method wanes significantly and consistently over time, and that high compliance rates are measured primarily during evaluations or shortly after studies. In addition, these studies hardly address the determinant of user compliance in full.

User motivation has recently become the focus of the SODIS research community. Thus, a series of systematic psycho-social studies identified certain individual (e.g., attitudes towards SODIS water or confidence in the method) and social factors (e.g., opinion of local leaders) that influence SODIS water uptake [6,7,15–17]. However, they did not thoroughly address how local belief systems may influence SODIS water uptake. For example, traditional models of illness in South America in general, and the Andean regions especially, attribute ailments to emotions, personal experiences, and social dimensions rather than to biological factors [18–20]. The ‘hot and cold’ theory is a classification system that describes the balance between physical and psycho-social states [21]. In this theory, qualities or attributes of bodily states, plants, and foods form part of a normative and dualistic system (i.e., hot/cold) and are exhibited as a continuum with gradations rather than a dichotomous system [22,23]. Different investigations have emphasised the importance of this theory for understanding food consumption patterns [24,25], however, there is limited evidence on how these interpretations can influence drinking water preferences.

In this paper, we investigate socio-cultural factors associated with SODIS water uptake in rural Andean Bolivia. We examine the principles of the ‘hot and cold’ theory (i.e., norms, values, and perceptions) associated with different types of drinking water (including SODIS water), as well as barriers to, and enablers of, SODIS water uptake.

## 2. Materials and Methods

### 2.1. Study Site

This study was embedded within a community randomised trial evaluating the health impact of the SODIS HWT method in 22 rural communities. The trial intervened with a SODIS educational programme in all households of the intervention communities, targeting primary caregivers and household members (bi-weekly), communities (monthly), and primary schools (three times) over 15 months [13,16]. The study site was located in the Totora district in the rural Bolivian Andes. Participating communities were widely dispersed at altitudes between 1700 and 3400 m. The ethnically homogeneous Quechua population was mainly subsistence farmers and kept livestock for personal consumption or sale. Participant families lived in compounds of two to four buildings with mud floors and without indoor water supply. Half of the participant families relied on unprotected springs as their predominant drinking water sources, their median distance to water sources was less than 50 m, and less than 30% reported treating their drinking water in any way before consumption. Sanitary facilities were present in less than 20% of the homes; stools were mainly deposited in the household vicinity. A full site description is found in [13]. Prior to the intervention, the prevalence of child

diarrhoea in the study area, designated as k'echalera in vernacular language, was between 7% and 12% [26]. While k'echalera represented the general term for frequent and watery diarrhoea, eleven additional vernacular sub-terms were used to classify gastrointestinal illnesses in children [27].

## 2.2. Data Collection

Data was collected between October 2005 and January 2006. We conducted 28 semi-structured, in-depth interviews (25 with women and three with men) in 11 intervention communities, and six focus group discussions (FGDs) (three in intervention communities and three in control communities). More women participated than men, as the latter were significantly more often constrained by time. As main breadwinners, men were heavily engaged in agricultural work and had to fulfil social obligations, which effectively limited their availability for the study. Sample size was determined by reaching saturation. Saturation was reached when no new relevant data emerged for a research topic and the properties and dimensions of the topic were well developed [28]. Participants (aged 18–50 years) were selected by convenience from the trial's study sample on the basis of their willingness to participate. All participants had previously already consented to participate [13].

We designed analytical guides for both interviews and FGDs on the basis of the principles of the 'hot and cold' theory. In FGDs, we sought to understand the local interpretations of drinking water and child diarrhoea. Conversely, in the interviews we aimed to identify barriers to, and facilitators of, SODIS water uptake. We did not conduct interviews in the control communities as we assumed their knowledge and perceptions of the SODIS method and SODIS water were based on social exchanges rather than direct use.

All materials were digitally audio-recorded in vernacular Quechua and transcribed in Spanish. A second person checked the transcriptions for accuracy. Data was collected by a small team composed by one anthropologist and two fieldworkers. They were trained following the principles and methods described in Dawson et al. [29].

## 2.3. Data Analysis

An anthropologist analysed the data using the qualitative data analysis software Weft QDA version 1.0.1. (Weft Corporation, UK). Results were grouped according to the topics proposed in the analytical guides. Codebooks were developed based on the classical principles of the 'hot and cold' theory [30] and the emic classifications of people. These codebooks were used for the computer-assisted analysis. The analysis was done according to the methods described in Dawson et al. [29]. This included a standard content analysis of FGDs and interview data. Themes were organised after coding the transcripts and new themes emerging during the analysis were also included. The resulting local interpretation of the 'hot and cold' theory classified drinking water according to the five categories of cleanliness, transparency, condition, essence, and taste. Research materials can be shared upon request.

## 2.4. Ethics

Ethical approval for the community randomised controlled trial ([ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT00731497) Identifier: NCT00731497) in which this study was embedded was obtained from the ethics commissions of the University of Basel, Switzerland, the University of California, Berkeley, and the University of San Simon, Cochabamba, Bolivia. Participants in the current study all came from households involved in the trial whose household member had provided a written informed consent (for full description, see [13]). We deleted community designations and participant names to ensure compliance with the ethical principles of the research.

## 3. Results

We identified five analytical domains: (i) local interpretations of child diarrhoea; (ii) awareness of drinking water contamination; (iii) SODIS method efficacy; (iv) the principles of the 'hot and cold'

theory applied to drinking water; and (v) barriers to, and facilitators of, SODIS water uptake. In the following section, we present these results in the aforementioned order.

### 3.1. Local Classification of Child Diarrhoea

Respondents described the patterns of symptomatic diarrhoea as very painful and unpleasant, afflicting small children especially. In discussing the causes of child diarrhoea (k'echalera), participants expressed six possible origins: (i) 'dirty' water containing 'bichos' ('bugs', i.e., pathogenic microorganisms); (ii) food (e.g., eating too much rotten food); (iii) dirtiness (e.g., not washing one's hands before eating); (iv) the cold entering into the body; (v) ingesting hot or very cold water; and (vi) jap'eqa—also known as 'fright sickness' [31,32]. Out of these six locally perceived causes of child diarrhoea, participants associated only the first with contaminated drinking water and considered it preventable through the use of SODIS water. Jap'eqa, on the other hand, was mentioned as the only life-threatening ailment causing diarrhoea. Participants described sacred places (i.e., hillsides and water sources) where Mother Earth (Pachamama) could provoke 'fright sickness' in people or animals that came into contact with water from these places. Participants associated jap'eqa with the loss of the soul; hence, they considered jap'eqa not preventable through the use of SODIS and treatable only through the help of traditional healers.

### 3.2. Perceptions of Risks Associated with Drinking Water

Most respondents remarked that SODIS promotion messages stressed all 'raw' water contained 'bugs'. However, villagers did not always agree with that statement:

**Moderator:** 'Have you ever seen these "bugs"?''

**Respondent 1:** 'We have not seen them, only the people from BoliviaWET have told us there are bugs. We have not seen them with our own eyes. If we saw them, they would disgust us, but if we don't see them, we drink the water as if there were just nothing in there.'

**Respondent 2:** 'If we saw the bugs, we would not drink the water. We would appreciate if they would just show us. We could believe it if we saw what type of "bugs" they are talking about.'

**Moderator:** 'Don't you trust them then?'

**Respondent 2:** 'Yes, yes, we do.'

**Moderator:** 'But you want to see them in order to believe it?'

**Respondent 1:** 'If we don't see, we don't believe. We ask ourselves, will it always be true? But we see our water is clean.'

Source: FGD with seven women (aged 22–40). Intervention community.

In this context of uncertainty, the perceived cleanliness of drinking water played a central role in assessing the presence of pathogens. According to the majority of respondents, water that was stagnant and turbid at times (described as 'dirty' water) was understood to carry high health risks. Some respondents explicitly stated that they only perceived an increased risk of diarrhoea if water contained visible 'bugs'. Another key factor that reduced the sense of risk associated with drinking water was habituation to potentially harmful pathogens. Among respondents, the idea of 'getting used to' appeared repeatedly. They indicated it was necessary to get used to the taste of SODIS or boiled water—but also to any particular drinking water (i.e., water with 'bugs')—in order not to become ill. In general, respondents argued they did not get ill from drinking 'raw' water because they were used to it:

**Moderator:** ‘When you drink a certain type of water, can you get diarrhoea or fall ill?’

**Respondent 2:** ‘No, our stomachs are already used to it [ ... ] Maybe we get diarrhoea from the water from another source.’

**Respondent 3:** ‘We don’t know where the diarrhoea comes from, because every day we drink this water, some of us since we were born.’

**Moderator:** ‘And doesn’t it affect you?’

**Respondent 3:** ‘We don’t know from what we get ill from. If we drank this water and fell ill shortly after, it could be. However, this is not the case. We drink this water every day.’

Source: FGD with 12 women (aged 20–50). Intervention community.

### 3.3. Perceived Efficacy of the SODIS HWT Method

All respondents did not consider the preparation of SODIS water laborious, complicated, or expensive. In fact, they only indicated a few reasons for not preparing SODIS water regularly, like having too much work to do, unfavourable meteorological conditions (i.e., the wind blowing the bottles off the roofs), or the lack of accessible bottles. In general, participants claimed to know how to prepare SODIS water, asserting that the method was useful to ‘kill the invisible bugs’ in the water. They compared the effect of SODIS to that of water boiling, a practice that was promoted by health centres during the cholera outbreaks of the 1980s and 1990s [33]. Only a few participants expressed doubts about the efficacy of the SODIS method. They indicated ‘bugs’ may remain in SODIS water if there was not enough sun, causing stomach pain if such water was ingested. Like the perceived risks associated with the presence of pathogens in ‘raw’ water, this was a matter of belief rather than of factual evidence—changes in health conditions due to SODIS water uptake were mostly indiscernible, according to respondents.

### 3.4. Local Classification of Drinking Water

For the majority of participants, the preference for hot or cold drinking water depended on the outside temperature and the level of physical activity. In hot weather or after hard work, they preferred cold water as it was conducive to work. By contrast, they preferred hot infusions in cold weather and in the mornings, and noted that drinking water must be boiled with herbs in wintertime in order to avoid stomach pain, especially in children. These respondents also repeatedly emphasised that drinking hot water without adding herbs, particularly in hot weather conditions, was harmful to one’s health as it inflated the stomach and produced abdominal pain. Hence, they considered water heated by the sun, including SODIS water, particularly dangerous if insufficiently cooled: ‘We leave the bottle on the roof for one day and for two days if it is cloudy. Then we collect it and drink it the next day. If you drink it hot, you get stomach pains’. (Interviewer: ‘Is it true? Can SODIS water give you diarrhoea?’) ‘Yes, hot water can provoke this’—Source: interview with a woman (age 32). Intervention community.

Local perceptions of drinking water indicated that cooling down water not only changed the temperature but also its ‘essence’ and inherent properties (i.e., taste and quality). The majority of participants remarked that neither boiled nor SODIS water could ever be consumed hot [34]. Participants’ narratives often referred to water as ‘raw’ (emerging from springs) or, conversely, as ‘boiled’ (treated with heat). Unlike the hot/cold dualism, their classification was process-related, not static: ‘boiled’ water remained cooked in essence, even when cooled afterwards. Water could be ‘boiled’ by means of fire or the sun. Hence, participants generally considered boiled and SODIS water to be ‘boiled’, although with graduations:

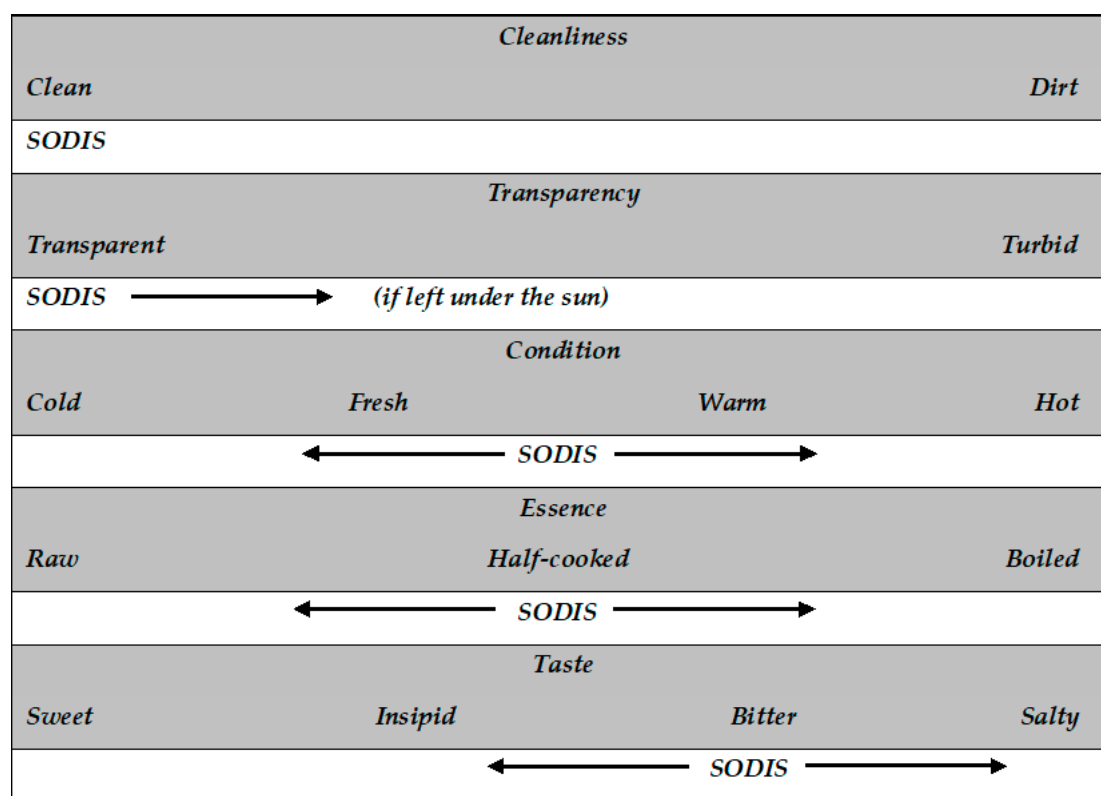
- a- ‘Boiled’ like boiled water, because ‘the sun boiled the water’,
- b- ‘Boiled’ but to a lesser degree than boiled water,

- c- Neither 'raw' nor 'boiled': 'it looks like "raw" water, but it is not because it is also sort of half-boiled. It has been cooked by the sun; thus, it doesn't appear natural anymore',
- d- 'Badly boiled' (closer to 'raw' water) and, therefore, potentially harmful: 'SODIS water is always "raw" as it is only warmed in the sun [ ... ]. Whereas boiling makes the water well-cooked, what does the sun do?'

In those cases where participants considered SODIS water proximal to 'raw' water, doubts emerged concerning the efficacy of SODIS. These differences in grade were clearly highlighted when respondents talked about the taste of SODIS water.

### 3.5. The Taste of SODIS Water as a Barrier for its Uptake

Participants used very specific terms—with either positive or negative connotations—to define the taste of drinking water: 'sweet', 'insipid', 'bitter', and 'salty'. They remarked that 'raw' water was the most valued type in terms of taste ('sweet'), and the least valued types were 'salty' and 'bitter' waters (i.e., 'raw' smelly water of stagnant ponds). Participants argued that the process of boiling or preparing SODIS water caused irreversible alterations of taste in particular. They indicated that water lost its 'sweetness' and became 'insipid', 'bitter', or 'salty'. Respondents asserted that SODIS water did not have any of the positive attributes of 'raw' water, but they considered it slightly more pleasant than boiled water, which they described as 'tasteless' and 'unpleasant' (Figure 1).



**Figure 1.** Solar disinfection (SODIS) of drinking water within the local interpretation of the 'hot and cold' theory.

Participants attributed this unattractive flavour to the smoke of the cooking fire, the kitchenware, and, especially, the process of boiling itself. This alteration affected the essence of the water, as it did not regain its 'sweetness', even when cooled down. When consuming boiled water, participants habitually added herbal leaves, lime, or spices (e.g., cinnamon). These infusions and refreshments were not only valued because of their taste; they were also considered prophylactic and therapeutic as



they transformed the essence of water. Adding ‘fresh’ plants transformed the water into a refreshment that could be used as a remedy against ‘hot fevers’. Adding ‘hot’ herbs, on the other hand, turned the water into a ‘hot’ beverage to treat illnesses caused by the ‘cold’.

Respondents mentioned two different explanations for the variations in the taste of SODIS water. For some participants, the SODIS method transformed water’s essence and, consequently, its taste ‘because the SODIS method also changes the water. If no air circulates inside, the taste changes’. In contrast, other respondents indicated that the bottles themselves affected the taste of SODIS water. They claimed that plastic bottles, when heated in the sun for a long time, generated a peculiar taste of ‘rubber’ or ‘plastic’ in water. Overall, all participants asserted that SODIS water tasted more like boiled (‘salty’ or ‘insipid’) than ‘sweet’ water because ‘the sun can heat [water] the same [as boiled water]’.

Those who reported using SODIS water regularly indicated they grew accustomed to its taste. In order to improve the taste of SODIS water, some respondents added lime or artificial soda powder.

All participants emphasised that pleasant drinking water must also quench thirst. In their opinion, ‘raw’ water fulfilled this requirement, whereas boiled and SODIS water, to some extent, were less effective: ‘SODIS water does not really satisfy me. I don’t know why, but it does not quench thirst’. For all these reasons, the majority of participants reported not consuming SODIS water regularly.

#### 4. Discussion

We conducted a qualitative study to investigate socio-cultural factors associated with SODIS water uptake in rural Andean Bolivia. This is, to our knowledge, one of the few studies that address socio-cultural factors of SODIS water from an emic perspective among a rural Andean population in South America. The study innovates in delving deeply into local meanings, values, and local classification relating to drinking water use when describing drinking water preferences, and when underscoring the importance of taking into account beneficiaries’ perspectives assessing water interventions.

Our results indicate that SODIS does not seem to be viewed as a desirable HWT method in rural Andean Bolivia despite its local public image as a simple, safe, low-cost means of preparing safe drinking water. Although all participants agreed that ‘raw’ water may contain ‘bugs’ or ‘worms’ of varying shapes and sizes, and that these have the potential to cause diarrhoea and other digestive problems, they still consume ‘raw’ water. This discrepancy between discourse and practice can be explained by the fact that the reiteration of health messages in the context of intensive health campaigns does not (necessarily) entail a change in attitudes [35]. Respondents mentioned the taste of SODIS water and its ambiguous classification within the principles of the ‘hot and cold’ theory as the two main barriers affecting its uptake. Participants perceived SODIS water to be ‘clean’, but they argued that exposure to sunlight made the water taste ‘insipid’ and ‘salty’ rather than ‘sweet’. This transformation made SODIS water appear less desirable and, thus, unsuitable for quenching one’s thirst. The classification of SODIS water as neither ‘raw’ nor ‘boiled’ generated doubts amongst participants about its effectiveness inactivating water-borne pathogens. We did not find clear local indicators of ‘clean’ versus ‘dirty’ water, but rather a blurred system of personal classifications [36].

Our findings are consistent with other studies that have explored factors of SODIS water uptake. In Bolivia, different investigations identified taste as a predictor of current and intended use of the SODIS HWT method [7,37]. In neighbouring Peru, studies described the beliefs that SODIS water caused stomach-aches and that piped water was clean and treated, as the main barriers to SODIS uptake [38]. In other Peruvian settings, changes in water characteristics due to direct sunlight exposure were associated with a perceived risk of disease. For this reason, householders only agreed to drink SODIS water if bottles remained exposed to moonlight to receive its ‘purifying effects’ [39]. Research in Indonesia found that although the SODIS method was considered to provide larger economical and time-saving benefits, negative perceptions of its taste and odour made HWT methods other than SODIS appear more desirable [40]. Perceived health risks, financial limitations, and the lack of bottles acted as barriers to the continuous uptake of SODIS water in Nepal and India [9].

There is evidence from various settings that socio-cultural factors influence the consumption of drinking water in general and SODIS water in particular [41–44]. We cannot attribute which extent socio-cultural factors in our study determine the uptake, rejection, or discontinuation of the SODIS HWT method. However, increasing the uptake of safe drinking water that a priori is not perceived as pleasant (like SODIS water) requires enhanced promotional activities. Such actions should not be restricted to health messages [45] or premises that knowledge and distribution of bottles will directly increase SODIS water uptake [5]. Evidence from Bolivia suggests that interpersonal strategies (e.g., household visits by promoters and positive opinions from local leaders) are more effective and less expensive than centralised ones [46]. Another longitudinal investigation in Zimbabwe revealed that households visited by trained promoters and the use of locally adapted behavioural change messages showed greater rates of SODIS water uptake even six months after project end [47]. In order to identify appropriate SODIS messages, it is important to pay attention to socio-cultural perceptions of SODIS water and incorporate them appropriately. For example, some of our participants suggested using herbs and additives to improve the taste of SODIS water. Therefore, investigating which particular plants would make SODIS water more pleasant tasting in rural Andean Bolivia could be an alternative to reconsidering key messages [48].

Contrasting all efforts to improve the implementation of the SODIS HWT method, it is also merited querying to what extent scaling an HWT method in general and the SODIS HWT method in particular is practical and feasible when adoption is not sustained over time. Whilst the efficacy of the SODIS method is undisputed, there is sufficient evidence demonstrating that sustained SODIS water uptake over time is limited and use decay is fast [10,11]. This phenomenon is also observed for other HWT methods with an initially user-expressed high desirability [49]. Compliance decay is observed even in cases where the SODIS method was chosen by future beneficiaries from an array of HWT options [12]. Different studies highlight the importance of achieving a critical 50% proportion of early and willing SODIS adopters to achieve a sustained SODIS coverage [6]. Nevertheless, reaching the ‘minimal- and non-adopter’ social groups is significantly challenged, as they commonly belong to the most marginalised and difficult-to-reach populations [16]. Thus, despite its efficacy, the SODIS HWT method may be considered as a household-based water treatment option for very specific situations only (e.g., in emergencies [50] or where social norms assure sustained use [51,52]). Along those lines, our results underscore that pre-assessments on local need, desirability and framework conditions for sustained adoption of the SODIS HWT method need to consider setting-specific profound cultural dimensions if no central water purification options can be provided.

#### *4.1. SODIS Water Within the Local Interpretation of the ‘Hot and Cold’ Theory*

The results of our research indicate that participants reinterpreted SODIS messages within the framework of the ‘hot and cold’ theory as they thought the SODIS method changed the inherent properties of water. We also observed that each of the different qualities of water could be linked symbolically with others. Associations between ‘stagnant’ and ‘sweet’ water were, theoretically, contradictory as these qualities also correlated—this is explicit in the narratives of our participants—with values related to health, taste (pleasant, tasteless), or bodily effects (quenching thirst, satisfaction). Understanding that any drinking water in rural Andean Bolivia is organised into a hierarchy of values and positioned within a continuum is important to designing and implementing effective interventions adapted to local needs and preferences. However, it is necessary to mention that these interpretations may be related to cultural meanings rather than to real perceptions. Blind-testing experiments conducted in a similar Peruvian Andean setting showed that when participants blindly chose different types of cold drinking water, they preferred SODIS over bottled, boiled, chlorinated, and tap (‘raw’) water, although they actively asserted that the taste of SODIS water was unpleasant when they knew it has been treated by SODIS [39]. In our setting, getting used to SODIS water means more than just getting accustomed to its taste; it is, in fact, an embodiment process. This principle is closely connected to the humoral theory of habituation, which describes the workings of the human body and was



widely adopted by early physicians and philosophers. According to this theory, the balance of different intrinsic humours (generated via ingestion) determines a healthy body. Although the ingestion of pathogens affects the body condition at the beginning, the theory describes a gradual adaptation to them, which is believed to have a protective effect. An example of this logic is the mithridatism, the practice of protecting oneself against a poison by gradually self-administering small amounts [53–55].

#### 4.2. Limitations

In this study, we identified the impact of cultural perceptions on the uptake of SODIS water applying qualitative methods. The design of this study did not allow making any inference to what extent these factors contribute to the use or decline of SODIS water uptake. In addition, we did not investigate other possible cultural factors associated with SODIS water, like social pressure and networks, attitudes, and practicalities (e.g., availability of bottles). We interviewed mainly women, as they were generally responsible for managing water consumption at the household level. We avoided conducting mixed-gender FGDs as we believed women would not speak as freely with the men present. Separate FGDs with men could not be arranged due to their limited time availability. Men were heavily engaged in agricultural work and had frequently to attend social obligations and community meetings. Different authors highlight the importance of adopting a multi-level perspective when studying the effectiveness of SODIS, including the analysis of enabling environments like government support and legal frameworks and other system factors, economic opportunities, and drivers of behaviour change [56]. Ideally, future research designs of randomised controlled trials should combine epidemiological, psychological, and anthropological methodologies exploring the systems context of this HWT. This integrative approach would provide better trans-disciplinary evidence on the basis of which in-depth conclusions on the impact of SODIS interventions may be drawn [57,58].

### 5. Conclusions

Solar disinfection of drinking water (SODIS) is a cost-effective household water treatment method (HWT) promoted in more than 50 African, Latin American, and Asian countries. We conducted a qualitative study to investigate socio-cultural factors associated with SODIS water consumption in rural Andean Bolivia. The rural population does not view SODIS as a desirable HWT method despite its local image as a simple, safe, low-cost means of preparing safe drinking water at home. Participants perceived a limited efficacy of SODIS water against diarrhoea—seemingly useful to prevent one type of diarrhoea only (out of six) that is caused by water containing ‘bichos’ (‘bugs’, i.e., pathogenic microorganisms). Moreover, they raised doubts about the perceived safety of SODIS water, as water heated only by the sun is perceived to be unsafe and ‘half-boiled’. Finally, the taste of SODIS water, which was perceived as unpleasant (‘salty’ or ‘insipid’) compared to ‘raw’ water, resulted in rejecting SODIS water among participants.

Understanding local interpretations of SODIS water is essential for framing and adapting promotion messages and for increasing its acceptance within local contexts.

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