PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Access to Improved Water and its Relationship with Diarrhoea in Kathmandu Valley, Nepal: A Population-Representative Survey
AUTHORS	Kondo, Naoki; Shrestha, Salina; Aihara, Yohko; Yoden, Kanako; Yamagata, Zentaro; Nishida, Kei

VERSION 1 - REVIEW

REVIEWER	Dr. Bandana K Pradhan Associate Professor Community Medicine and Public Health Department Institute of Medicine Tribhuvan University Nepal
REVIEW RETURNED	23-Dec-2012

THE STUDY	The research question is not clear.
RESULTS & CONCLUSIONS	It is confusing. It needs more clarity
GENERAL COMMENTS	English editing is required. Methodological clarity is low and findings are confusing/unclear. Discussion is ambiguous.

REVIEWER	Wolf-Peter Schmidt Lecturer LSHTM London, UK
REVIEW RETURNED	02-Feb-2013

THE STUDY	In public health research and epidemiology there is a trend to avoiding terms like "statistically significant" and focus instead on the effect size as given by the OR s, and describe the strength of the evidence more gradually (e.g. some evidence, good evidence, strong evidence etc...) rather than a simple cut – off at p= 0.05. I recommend to change this accordingly. For a some explanation on how to report results see perhaps Sterne BMJ. 2001 January 27; 322(7280): 226–231. I did not fully understand the statistical analysis. Rather than doing an analysis at individual level adjusted for correlation within households, the authors apparently did a household level analysis. I am not sure how household size was accounted for. Isn't it more likely that large household has a case of diarrhoea, simply because there are more people in it?
GENERAL COMMENTS	General: This article presents a relatively simple analysis of the effect of water availability and diarrhoea, in an area where residents get water from public networks, other sources or both. The main finding is that the type of water supply does not affect diarrhoea risk, while the quantity

of water consumed (regardless of source type) does.
This study confirms water quantity as the most important variable in the link between water availability and health, with water quality (earlier regarded as the most important factor) gains importance largely once the demand for sufficient water quantities is met.
While the results may not be ground breaking, they do add to the literature because of the relatively large sample size and apparently rigorous sampling procedure.
The main issue with this type of analyses is residual confounding which is always present unless all confounder are measured with 100% accuracy, which is impossible. Residual confounding should be mentioned in the limitation section.

Minor points:

Abstract: i think it is not needed to list all confounding variables, perhaps just mention variable categories, eg socio-economic/demographic variables etc

Page 4, line 52: perhaps rather say that the study aimed at measuring water consumption as accurately as possible – none of the measures are perfect.

Introduction: better say diarrhoea is a leading cause of diarrhoea, not the leading cause, and it may only be a leading cause in young children.

Page 7 line 17: perhaps better talk of risk of diarrhoea rather than chance

Page 8 line 10: what is meant by discriminated population? Is it a caste or migrants or just poor people?

Page 10 line 7: are these castes or true ethnic groups?

REVIEWER	Joe Brown Lecturer, Department of Disease Control, Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, United Kingdom I declare I have no competing interests that would influence my providing an objective review of this manuscript.
REVIEW RETURNED	04-Feb-2013

THE STUDY	The abstract and some of the methods are difficult to decipher due to poor English. I was not completely clear on the research question or the method of analysis until I got to the Results section.
RESULTS & CONCLUSIONS	Although this paper does, in the end, provide an interesting analysis of this secondary data set to answer a compelling research question, presentation of the methods and analysis is unclear and generally confusing. The Discussion does not include a fluent description of other recent studies examining this relationship between water access and health.
REPORTING & ETHICS	The authors state that Ethics approval is not needed as this was a secondary data analysis, but at my institution (and many others),

	such approval is required, if only to ensure that identifying details of subjects are redacted. The authors need to include more information on this point.
GENERAL COMMENTS	This is an interesting paper exploring the association between water quantity and health. Although the paper needs major revision, it is valuable work and merits publication in my opinion.

Specific comments:

1. This paper would benefit from careful review of language used. Use of inexact terms and grammar errors were evident. In some cases, grammar errors can make it difficult to interpret the meaning.

2. A major limitation of this study is that all data were self-reported. This needs to be explored more fully under "limitations" in the Discussion. Are one-month recall periods for diarrhoea plausible? Although the authors state that the method for estimating water use is accurate, this is just self-report also.

3. The authors need to stress in the abstract and elsewhere that this is a secondary data analysis and that they did not undertake this survey.

4. The authors do need ethical clearance for this study as it contains human subjects data. There may be no concerns due to identifying details being redacted, but institutional oversight is generally required in these cases.

5. Why did 20% of households refuse to participate in the survey? Did households refuse at random? Or is this evidence of a bias creeping into the data?

6. I recommend the authors revise the stats tables to be clearer and easier to interpret. They may need to break up the data into sub-tables.

7. In the introduction, the authors state that "Improvement in the water supply system is the key to prevention of diarrhoea". What about sanitation and hygiene? "A key" (rather than "the key") might be the better phrasing here. |

VERSION 1 – AUTHOR RESPONSE

Reviewer 1

#1 The research question is not clear. It is confusing. It needs more clarity. English editing is required. Methodological clarity is low and findings are confusing/unclear. Discussion is ambiguous.

We thank you for your comments. We have thoroughly revised our manuscript's Introduction, Methods and Discussion sections. Because your comments are general and related to the comments provided by other reviewers, please refer to our specific responses to the comments provided by other reviewers.

Reviewer 2
#2 In public health research and epidemiology there is a trend to avoiding terms like "statistically significant" and focus instead on the effect size as given by the OR s, and describe the strength of the evidence more gradually (e.g. some evidence, good evidence, strong evidence etc...) rather than a

simple cut – off at p= 0.05. I recommend to change this accordingly. For a some explanation on how to report results see perhaps Sterne BMJ. 2001 January 27; 322(7280): 226–231.

We appreciate your kind suggestion. As per your comment and the suggested reference, we amended our interpretation of odds ratio rather than using a simple cut-off at p = 0.05 in Table 2 (page 26), Table 3 (page 28) and the Results section.

Following changes have now been made in the Results section.

Page 12, Line 21 to page 13, line 1-3 (Results):
Adjusting for socio-demographic and behavioural variables slightly attenuated this association the adjusted OR was 2.53 (95% CI:1.10–6.33) for those with access to less than 20 l/c/d of water, even after adjusting for multiple confounding factors (model 2 in Table 2).

Page 13, Line 4-11
Regarding water sources, OR of contracting diarrhoea among household members was 1.33 (95% CI: 0.92–1.93) for households that used combined water sources, whereas the adjusted OR was 0.74 (95% CI: 0.44–1.24) for those using alternative water sources only as compared to those using improved water sources only. After accounting for variations in socio-demographic and behavioural variables, the adjusted OR for households using combined water sources was 1.81 (95% CI: 1.00–3.89), whereas the adjusted OR for households using alternative water sources only was 0.95 (95% CI: 0.36–2.49).

Page 13, Line 22-23 to page 14, line 1-2
The ORs for contracting diarrhoea among households without optimal access (100 l/c/d) to improved water tended to be higher than those with full access, whereas the ORs were less than or equal to 1 when the association between improved water access and diarrhoea was tested with alternative thresholds (i.e. 50 l/c/d or 20 l/c/d).

#3 I did not fully understand the statistical analysis. Rather than doing an analysis at individual level adjusted for correlation within households, the authors apparently did a household level analysis. I am not sure how household size was accounted for. Isn't it more likely that large household has a case of diarrhoea, simply because there are more people in it?

We appreciate your comment. The information on diarrhoea in ADB data was at a household level. As mentioned in the Methods section, this question was asked at a household level rather than at an individual level. If any of the family members in a household had diarrhoea, then the household was categorised as having diarrhoea. This could have caused an information bias. However, the effect of variations in household size on our findings may be small, as we did not find any significant association between household size and the onset of diarrhoea. To explain the same, we have added the following sentences:

Page 12, line 4-7 (Result)
Average age of household head was 47 years old and median family size was four. Average age of household head and family sized were not associated with the likelihood of contracting diarrhoea among family member (p=0.97 and 0.27, respectively).

Page 17 line 4-7 (strengths and limitations)
Information on diarrhoea was at a household level and did not account for household size. However, the impact of this may have been limited as we did not find any association between household size and the likelihood of having diarrhoea among family members.

#4 The main issue with this type of analyses is residual confounding which is always present unless all confounder are measured with 100% accuracy, which is impossible. Residual confounding should be mentioned in the limitation section.

In the revised manuscript, we have now mentioned the possibility of residual confounding in the limitation section.
Page 17 line 14-15
Therefore, estimates could be biased due to residual confounding of some unmeasured variables.

#5 Abstract: I think it is not needed to list all confounding variables, perhaps just mention variable categories, eg socio-economic/demographic variables etc

As per your suggestion, we have revised the Abstract and mentioned the variable categories collectively as socio-economic/demographic variables.
Page , line 3.

#6 Page 4, line 52: perhaps rather say that the study aimed at measuring water consumption as accurately as possible – none of the measures are perfect.

Thank you for your suggestion. We have made a correction on page 5, line 3–4: 'This study aimed to measure water consumption as accurately as possible'.

#7 Introduction: better say diarrhoea is a leading cause of diarrhoea, not the leading cause, and it may only be a leading cause in young children.

We have revised this sentence as per your suggestion:
Page 6 line 2 – 3
Diarrhoeal diseases are a leading cause of morbidity and mortality in less developed countries, especially among young children.

#8 Page 7 line 17: perhaps better talk of risk of diarrhoea rather than chance

As per your comment, we have made the appropriate revision and used the phrase 'risk of diarrhoea' rather than 'chance' on page 7, line 15.

#9 Page 8 line 10: what is meant by discriminated population? Is it a caste or migrants or just poor people?
#10 Page 10 line 7: are these castes or true ethnic groups?

Dalit is an ethnic group. In Nepal, most ethnic groups have their 'positions' in the caste system. The Dalits are usually believed to be discriminated against in the society, and they may sometimes have less access to resources. To present this clearly, we have revised some sentences as follows.

Page 11, line 5-8
In Nepal, the Dalit experience discrimination in terms of income, educational opportunities and health status compared with people of other ethnicities.16 In Nepal, ethnicity is another dimension of castes in addition to traditional social class categories, and some ethnicities, such as Dalit, are likely to be disadvantaged in many aspects.

Reviewer 3
#11 The abstract and some of the methods are difficult to decipher due to poor English. I was not completely clear on the research question or the method of analysis until I got to the Results section. Although this paper does, in the end, provide an interesting analysis of this secondary data set to answer a compelling research question, presentation of the methods and analysis is unclear and generally confusing.

We apologise for our poor arguments and English usage. To clarify our research question and analytical methods, we revised some parts of the Abstract, Introduction, Methods, and Discussion sections. These revisions should make our manuscript easier to interpret.

Page 2 line X: 2 – 4 (Abstract)
Objective: To assess the associations between diarrhoea and types of water source, total quantity of water used and quantity of improved water used in rapidly-developing, highly-populated urban areas in developing countries.

Page 2, Line 15-22 to page 3 line 1-4
Result: Regarding water quantity, for households in which family members consumed less than 100 litres per capita per day (l/c/d) of water, which is the quantity recommended by the World Health Organisation, the risk of contracting diarrhoea doubled (1.56–2.92 times). Regarding differences in types of water sources, for households that used alternative water sources (such as wells, stone spouts and springs) in addition to improved water (provided by a water management authority), the likelihood of contracting diarrhoea was 1.81-fold higher (95% confidence interval: 1.00–3.29) than for those that used improved water only. However, access to an improved water source was not associated with a lower risk of having diarrhoea if optimal quantities of water was not consumed (i.e. <100 l/c/d). These results were independent of socio-economic and demographic variables, daily drinking water treatment practices, toilet facilities and residential areas.

Page 6, line 23 to page 7 line 1-2 (Introduction)
This met the MDGs goal of population coverage in terms of providing safe water, although the quantity of water provided was insufficient.

Page 7, Line 9 – 18
Because many urban cities such as Kathmandu have suffered from a serious shortage in water sources, an evaluation of the impact of accessibility to water in terms of its quality and quantity is critical for planning future public health interventions. Therefore, the aims of this study were to (1) evaluate the impacts of accessibility to water in terms of its quality (water provided by KUKL or obtained from alternative sources such as wells, stone spouts and springs) and quantity (daily quantity available per capita) on the risk of diarrhoea and to (2) identify the quantity of improved (i.e. KUKL-provided) or alternative water that is necessary to prevent diarrhoea. In addition, to identify vulnerable populations with regard to accessibility to water, we evaluated the association between socio-economic status and diarrhoea.

Page 10, line 5-16 (Method)
According to the definition, 20 l/c/d is sufficient for consumption but hygiene may be compromised (basic access); 50 l/c/d may meet the requirement for consumption, hygiene and laundry (intermittent access) and 100 l/c/d is sufficient for all purposes (optimal access).

In addition, the coverage of access to KUKL-provided improved water against the quantities recommended by WHO was calculated as,

Total amount of improved water used (l/c/d) / A × 100 (%)

where A takes a value of 20 l/c/d for basic access to improved water, 50 l/c/d for intermediate access or 100 l/c/d for optimal access. Then, households were categorised into the following three groups on the basis of the coverage: fully covered (100% or more), partially covered (1%−99%) and not covered (0%) for each category of given access to water as recommended by WHO.

Page 10, Line 15-18 (Statistical analysis)
To evaluate differences in the 1-month prevalence of diarrhoea at a household level (i.e. the percentage of households reporting the incidence of diarrhoea in the previous month), chi-square test and Fisher's exact test were used for categorical variables and Mann–Whitney U test and t-test were used for continuous variables.

Page 13, line 2-15 (Discussion)
As per our study, although using alternative water sources in addition to improved water was associated with a higher risk of diarrhoea than those using improved water only, limited access to water in terms of quantity (i.e. less than the WHO-recommended optimal amount of 100 l/c/d), regardless of any source used, was more strongly associated with contracting diarrhoea. Moreover, access to minimal (20 l/c/d) and intermediate (50 l/c/d) quantities of improved water was not associated with diarrhoea. Disadvantaged socio-economic status, particularly as reflected by poor educational level of the household heads, was also independently associated with a high likelihood of having diarrhoea. On the basis of these findings, priority should be given to securing access to sufficient quantities of water rather than limited access to improved water (less than 100 l/c/d). Therefore, the results of this study support the WHO recommendation of providing accessibility to 100 l/c/d of water, which is the quantity required to prevent diarrhoea, although it may be regardless of the degree of accessibility to an improved water supply.

#12 The Discussion does not include a fluent description of other recent studies examining this relationship between water access and health.

We have included information from previous studies that examined the relationship between accessibility to water and health. In the revised manuscript, we have attempted to explain these descriptions as fluently as possible. Please refer to the following sentences in the Discussion section.

Page15, line 16-19
In addition, Masangwi et al. conducted a baseline survey of 1014 households in Malawi which demonstrated that despite a positive impact of improved piped water in reducing diarrhoea, the impact was limited to areas where the supply service was unreliable.

#13 The authors state that Ethics approval is not needed as this was a secondary data analysis, but at my institution (and many others), such approval is required, if only to ensure that identifying details of subjects are redacted. The authors need to include more information on this point.
The authors do need ethical clearance for this study as it contains human subjects data. There may be no concerns due to identifying details being redacted, but institutional oversight is generally required in these cases.

We apologise for our mistake in the manuscript. The protocol of this study was approved by the Ethical Review Board of the University of Yamanashi School of Medicine. We modified the following sentences.

Page 8, line 1 (method)
No personal identifiers were included in the data.

Page 8 line 18-23 (methods) & Page 19 line 13-15 (ethical approval):
The protocol of this study was approved by the Ethical Review Board of the University of Yamanashi School of Medicine.

#14 This paper would benefit from careful review of language used. Use of inexact terms and grammar errors were evident. In some cases, grammar errors can make it difficult to interpret the meaning.

We have used native English check service for our revised manuscript.

#15 A major limitation of this study is that all data were self-reported. This needs to be explored more fully under "limitations" in the Discussion. Are one-month recall periods for diarrhoea plausible? Although the authors state that the method for estimating water use is accurate, this is just self-report also.

We have included these points in the 'Strengths and limitations' section.

Page 17, line 3-12
Despite these advantages, some limitations should be noted. First, the onset of diarrhoea and other variables were self-reported. Information on diarrhoea was at a household level and did not account for household size. However, the impact of this may have been limited as we did not find any association between household size and the likelihood of contracting diarrhoea among family members. Moreover, a family member was asked to recall the incidences of diarrhoea among family members in the previous month. This may have resulted in a recall bias. For example, occurrence of diarrhoeal episodes over nearly a month may be underreported as family members may have forgotten about them; this may have caused an underestimation of the number of diarrhoeal events.

#16 The authors need to stress in the abstract and elsewhere that this is a secondary data analysis and that they did not undertake this survey.

In the Abstract section of the revised manuscript, we have mentioned that we used secondary data analysis. Please refer to the following sentence:

Page 2, line 5 (abstract)
Cross-sectional analysis using population-representative secondary data obtained from an interview survey conducted by the Asian Development Bank for the 2009 Kathmandu Valley Water Distribution, Sewerage and Urban Development Project.

#18 Why did 20% of households refuse to participate in the survey? Did households refuse at random? Or is this evidence of a bias creeping into the data?

Unfortunately, we did not have access to this data; therefore, we could not evaluate the reasons for refusing to participate in the survey. Although the response rate was not small for this type of field survey, any non-responding could have been a source of bias. To explain this, we have added some sentences in the Methods and Strengths and limitations sections.

Page 8, line 18-20 (Methods)
Approximately 20% households refused to participate in this survey. Data for comparing participants and non-participants in terms of their characteristics were thus unavailable.

Page 17, line 19-21 (Strengths and limitations)
Fourth, although a response rate of 80% is not low, we could not evaluate whether the non-

responding were random. Thus, possible selection bias should be considered when interpreting the results of our study.

#19 I recommend the authors revise the stats tables to be clearer and easier to interpret. They may need to break up the data into sub-tables.

We have revised the tables to make them clearer and as self-explanatory as possible. Please refer to the tables in the revised manuscript (pages 23, 26 and 28).

#20 In the introduction, the authors state that "Improvement in the water supply system is the key to prevention of diarrhoea". What about sanitation and hygiene? "A key" (rather than "the key") might be the better phrasing here.

We appreciate your suggestion. We have accordingly revised this sentence.
Page 6 line 6
Improvement in the water supply system is a key to prevention of diarrhea.

VERSION 2 – REVIEW

REVIEWER	Bandana K Pradhan Professor Community medicine and public health department Institute of Medicine Tribhuvan University, Nepal
REVIEW RETURNED	10-Apr-2013

THE STUDY	Is the overall study design appropriate and adequate to answer the research question? Diarrhea is waterborne disease and not shown any relation with the quality of water. Are the participants adequately described, their conditions defined, and the inclusion and exclusion criteria described? Not clear Are the patients representative of actual patients the evidence might affect? Not mentioned Are the methods adequately described? Not described How does the information of in-depth interview analysed ? Is the standard of written English acceptable for publication? Editing requires Are the references up to date and relevant? (If not, please provide details of significant omissions below.) Not national references especially policy reports are not referred.Do any supplemental documents e.g. a CONSORT checklist, contain information that should be better reported in the manuscript, or raise questions about the work? Operational definitions can be added such as diarrhea, improved water, disadvantaged socioeconomic status etc.
RESULTS & CONCLUSIONS	Do the results answer the research question? No, for that the statement should be considered.

	What is the general scenario of diarrheal disease and water quality condition of Kathmandu valley?? Are they credible?
	There is the question of reliability and validity of the information. The perception of diarrhea vary from person. No operation definition considered in the manuscript
	Are the interpretation and conclusions warranted by and sufficiently derived from/focused on the data?
	Are they discussed in the light of previous evidence? Some references at least government policy, Water plan, water quality standard.
	Information on in-depth interview is not seen and how it is being analysed?
GENERAL COMMENTS	The water quantity used should be discussed with reference to national standard of Nepal which is existing. Policy review is missing. In conclusion part how come Melamchi issue which is not been addressed in findings as well as in discussion. Still sweeping remarks are seen in the manuscript, avoid those remarks and try to figure them out. In the methodology it is mentioned that information is based on in-depth interview but the information has been analysed by only quantitative technique how do you justify it?

| REVIEWER | Joe Brown London School of Hygiene and Tropical Medicine United Kingdom

I declare no competing interests. |
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| REVIEW RETURNED | 01-Apr-2013 |

| THE STUDY | The burden of disease estimates given in the introduction are from 2004, almost 10 years ago. The authors should cite more current sources.

The interpretation of the data presented in this paper is completely dependent on the accuracy of the confounding analysis, and the authors seem to expect that we will take their very brief description as word that they have done the due diligence on assessing and adjusting for confounding. This study could be made much stronger with a few additional details on the confounding analysis in the Methods section. What criteria were used to identify confounders or effect measure modifiers? How were variables added or subtracted from regression models? Presenting the unadjusted and adjusted estimates in tabular form might help.

This is a potentially important paper but if this part is not adequately addressed it may cause some readers to discount it as a probable co-linear factor with wealth. |
| --- | --- |
| GENERAL COMMENTS | This is an important manuscript and I urge you to include the additional details on how you identified and assessed confounders in your regression models. This information is critical to interpretation of your data. |

Reviewer 1: Dr Joe Brown
1) The burden of disease estimates given in the introduction are from 2004, almost 10 years ago. The authors should cite more current sources.

We appreciate suggestion. We added the latest information on introduction section in the revised manuscript. We have cited a WHO article published in 2013.
Page 6, Line 3-6
Currently, approximately 1.7 billion cases of diarrhoeal disease are observed every year,[1] and approximately 1.5 million people have died worldwide because of diarrhoea, 80% of whom were in sub-Saharan Africa and South Asia.[1, 2]

2) The interpretation of the data presented in this paper is completely dependent on the accuracy of the confounding analysis, and the authors seem to expect that we will take their very brief description as word that they have done the due diligence on assessing and adjusting for confounding. This study could be made much stronger with a few additional details on the confounding analysis in the Methods section. What criteria were used to identify confounders or effect measure modifiers? How were variables added or subtracted from regression models? Presenting the unadjusted and adjusted estimates in tabular form might help.

This is a potentially important paper but if this part is not adequately addressed it may cause some readers to discount it as a probable co-linear factor with wealth.

This is an important manuscript and I urge you to include the additional details on how you identified and assessed confounders in your regression models. This information is critical to interpretation of your data.

These are very helpful comments, and we agree with these. In model 1 (Table 2), all variables listed were included in the analysis. This is so for model 2, too, except for residential areas that consisted of 51 dummy variables. It is possible that some variables we adjusted for in our multivariate analysis can be mediators rather than confounders. Specifically, sanitary behaviour may be influenced by the access to water and can cause high diarrhoea risks. However, we did not find strong changes in main effects between unadjusted models (univariate model in table 2) and the models adjusted for sanitary behaviour (model 1). Moreover, the odds ratio of the variables on sanitary behaviour did also not largely change. Therefore, we have decided not to discuss about the roles of these factors in our causal inference on the impact of water use and diarrhoea, due to limited space. We rather thought that the roles of residential areas may be more important in interpreting our models. On this point, we added more detailed information on our ways to handle confounding factors, putting some weights on residential areas, as follows.

Page 11, Line 2-6 (Method)
We theoretically identified potential confounding factors, the factors potentially affecting both the access to or the use of water and the chances of having diarrhoea. We considered the following potential confounding factors: demographic variables, socio-economic status, sanitary behaviour, toilet facilities, and residential areas. Although some factors were mildly correlated to one another, our preliminary analysis confirmed that the factors did not cause serious multicollinearity in multivariate analysis.

Page 12, Line 11-16 (Method)
We used this two-step approach because, in our preliminary analysis, the impact of residential areas on variations in the main fixed effect was relatively large. Moreover, although residential areas can strongly influence the accessibility to water, the impact of residential areas can be concurrent with that

of other variables, including water access, socio-economic status and sanitary environment, potentially causing overadjustment

Page 17, Line 19-22 to Page 18, Line 1-2 (Strength and Limitations)
For example, although we controlled for the fixed effects of residential areas, we did not know whether the area unit used was completely valid in capturing the geographic variations in the context of KUKL water supply, sociodemographic characteristics and culture or behaviour on water use. Given this, further studies that formally model those contextual effects would be warranted.

Reviewer 2: Dr. Bandana K Pradhan

3) Is the overall study design appropriate and adequate to answer the research question?
Diarrhea is waterborne disease and not shown any relation with the quality of water.

We thank Dr Pradhan for pointing out this. It is true that in our study we didn't consider the detailed laboratory analysis of water quality. Our strategy has been to use the types of water source as a proxy measure of water quality we can best apply in this interview survey.

We have added a sentence on this point in the limitation section.

Page 18, Line 4-7
Finally, we did not evaluate the quality of water that was sampled as the water domestically used in each household. Further studies should evaluate the actual quality of water taken from various sources.

4) Are the participants adequately described, their conditions defined, and the inclusion and exclusion criteria described?
Not clear

For more clarification on study sampling, we modified the methods section as follows.

Page 8, Line 8-17:
A multistage cluster sampling method was used. Data collection involved two stages. In the first stage, 35 wards from five municipalities and 15 VDCs were randomly selected. In the second stage, 84 geographical points were randomly selected from these municipalities and VDCs. Interviewers then visited the selected geographical points and interviewed family members residing in households located closest to these points. A total of 2282 households were included in this study; one person per household was interviewed using a structured questionnaire. No specific exclusion criteria were used. Any kind of household was selected, including both rented and owned. The households in which the members could not be contacted by the interviewers, despite multiple visits, were excluded.

5) Are the patients representative of actual patients the evidence might affect? Not mentioned

We have mentioned about the representativeness of our sample in the limitation section:

Page 17, Line 5-6, Line 10-13
The survey was strictly controlled in terms of quality as it involved random sampling. Despite these advantages, some limitations should be noted. Information on diarrhoea was at a household level and did not account for household size. However, the impact of this may have been limited as we did not find any association between household size and the likelihood of contracting diarrhoea among family members.

6) Are the methods adequately described? Not described

We have tried to improve the methods section more, referring to globally recognized guidelines such as STROBE checklist for reporting cross-sectional studies. According to STROBE, study design, setting, participants, variables, data sources/measurement, effort to reduce bias, study size, quantitative variable, and statistical methods should be reported. We have reviewed the methods section again and made corrections clarifying vague or missing descriptions. We modified some sentences: page 11, line 2-6, page 12, line 11-16 page 17, line 19-22 to page 18, line 1-2

Moreover, please refer to our response to the second comment of the reviewer #1.

7) How does the information of in-depth interview analysed ?

We intended to say that we gathered information on water use by in-depth interviews to maximize the accuracy of the information. However, "in-depth" may be a confusing word and we have not used the word any more in the revision, just saying that we used a structured questionnaire.

Page no. 5, line no. 2 – 5 (Article summary)
This study used large-size population-representative data obtained by interviews using a structured questionnaire on water consumption, socio-economic status and living conditions. This study aimed to measure water consumption as accurately as possible.
Page 8, line 13-14 (Method)
A total of 2282 households were included in this study; one person per household was interviewed using a structured questionnaire.

8) Is the standard of written English acceptable for publication? Editing requires

All versions of our manuscript so far have been checked by commercial native English check & edit services for academic articles. To respond to this reviewer's comment, this time, we requested our service agency to check very carefully and thoroughly. We hope English description of the current version is satisfactory for this reviewer.

9) Are the references up to date and relevant? (If not, please provide details of significant omissions below.) Not national references especially policy reports are not referred. Do any supplemental documents e.g. a CONSORT checklist, contain information that should be better reported in the manuscript, or raise questions about the work?

We replaced information on the current epidemiology of diarrhoea worldwide by the latest one in the introduction section in page 6, line 2-5. Please follow our response to the first comment of reviewer #1.
We also added a reference published by the Government of Nepal: 'Government of Nepal. Nepal Urban water Supply and Sanitation Sector Policy'. Nepal; 2008
Page 7, Line 4-9
In addition, the national policy document16 stressed on improving the health status of urban population by the provision of sustainable water supply and sanitation. Despite the aforementioned policy, high coverage and fulfilment of the MDG goal; the service provided by KUKL was not evaluated in terms of water quantity and system reliability; hence, its usefulness is still questionable. CONSORT statement is for randomized clinical trials, which does not fit to this manuscript. When we prepare our manuscript, we followed the STROBE checklist for cross-sectional studies, and confirmed that our manuscript contained all information recommended.

10) Operational definitions can be added such as diarrhea, improved water, disadvantaged

socioeconomic status etc.

For the definitions of diarrhea, improved water, disadvantaged socioeconomic status etc, we reviewed again the clarity of our definitions in the text and amended unclear descriptions as follows. As for the definition of 'disadvantaged socioeconmic status', we confirmed that its meaning were explained in each sentences that used this term. The followings are the sentences we have modified or those mentioning about these definitions:

Page 9, Line 5-10 (Method)
Diarrhoea was determined by asking the question 'Did you or anyone in your family get sick last month? If yes, what was the illness? The answer to this question included the following 10 common ailments: fever, common cold, diarrhoeal disease, dengue fever, hepatitis, typhoid, malaria, skin disease, infected wounds and other illnesses. Surveys from households that selected the response 'diarrhoeal disease' were categorised as having diarrhoea.

Page 9, Line 17-19 to Page 10, Line 1-2 (Method)
Responses were categorised into the following groups: (1) improved sources only (treated water provided by KUKL); (2) alternative sources only (water exclusively obtained from dug wells, tube wells, stone spouts, springs, rivers, rain water, jar water and tanker supply) and (3) combined water sources (both improved and alternative).

Page 10, Line 11-14 (Method)
In this study, we determined 'improved water' as the water provided by KUKL Thus, coverage of access to KUKL-provided improved water against the quantities recommended by the WHO was calculated using the following equation:
Total quantity of KUKL-provided water consumed (l/c/d) /A × 100 (%)

Page 14, Line 4-7 (Result)
This association was most clearly evident for the income level, educational level attained and dalit ethnicity. The households with the lowest income were 1.32-fold more likely to contract diarrhoea (95% CI: 0.70–2.47).

Page 15, Line 5-7 (Discussion)
Disadvantaged socio-economic status, particularly reflected by lower income level, poor educational level of the household heads and dalit ethnicity were also independently associated with a high likelihood of having diarrhoea.

11) Do the results answer the research question? No, for that the statement should be considered. What is the general scenario of diarrheal disease and water quality condition of Kathmandu valley?? Are they credible? There is the question of reliability and validity of the information. The perception of diarrhoea varies from person. No operation definition considered in the manuscript.

As per suggestion, we included the water information about diarrhoeal disease and water quality condition in the Kathmandu valley in the introduction section

Page 6, Line 20-22
Regarding diarrhoeal diseases, of the total outpatient department (OPD) visits, 8.2% were patients with diarrhoeal disease in the Kathmandu Valley.[1]

Page 7, Line 11-13
A study also showed that microbial contamination is prevalent in most of the water sources in the Kathmandu Valley.[19]

We recognise that validity and reliability of the definition of diarrhoea in this study. We modified the

limitation section for more clarity.

Page 17, line 9-18
First, the onset of diarrhoea and other variables were self-reported, relying on the respondents' perceptions of diarrhoeal symptoms. Information on diarrhoea was at a household level and did not account for household size. However, the impact of this may have been limited as we did not find any association between household size and the likelihood of contracting diarrhoea among family members. Moreover, a family member was asked to recall the incidences of diarrhoea among family members in the previous month. This may have resulted in a recall bias. For example, occurrence of diarrhoeal episodes over nearly a month may be underreported as family members may have forgotten about them; this may have caused an underestimation of the number of diarrhoeal events.

12) Are they discussed in the light of previous evidence? Some references at least government policy, Water plan, water quality standard.

We added more references regarding governmental policies (No #16) and conditions of diarrhoea in Nepal (No #13).

Page 6, Line 20-22
Regarding diarrhoeal diseases, of the total outpatient department (OPD) visits, 8.2% were patients with diarrhoeal disease in the Kathmandu Valley.

Page 7, Line 4-9
In addition, the national policy document16 stressed on improving the health status of urban population by the provision of sustainable water supply and sanitation. Despite the aforementioned policy, high coverage and fulfilment of the MDG goal; the service provided by KUKL was not evaluated in terms of water quantity and system reliability; hence, its usefulness is still questionable.

Page 18, Line 20-22
In addition, there is an urgent need for the proper monitoring of existing plans and policies that promote the health benefits of people by providing an efficient water supply service.

13) The water quantity used should be discussed with reference to national standard of Nepal which is existing. Policy review is missing. In conclusion part how come Melamchi issue which is not been addressed in findings as well as in discussion. Still sweeping remarks are seen in the manuscript, avoid those remarks and try to figure them out. In the methodology it is mentioned that information is based on in-depth interview but the information has been analysed by only quantitative technique how do you justify it?

We appreciate for these useful comments. For the first point, we used WHO guideline values for water quantity for the analysis. This is because we want to make the results our study being generalized in the context of urbanizing areas of developing countries worldwide. However, we agree that it would be more useful to use the national standard of Nepal, when using the evidence for domestic policies. We will think of writing a spin-off paper using the national standard and will submit it as another paper to a domestic journal in the future.

For the second comment, considering the given suggestion, in the revised manuscript we have removed our discussion on the Melamchi issue.

Regarding third comment on the policy review and in-depth interview, we have not used the term 'in-depth' anymore. Please see our response to this reviewer's earlier comment.

REVIEWER	Prof. Dr. Bandana Pradhan Department of Community Medicine and Public Health Institute of medicine Tribhuvan University, Kathmandu, Nepal
REVIEW RETURNED	09-May-2013

THE STUDY	Is the standard of written English acceptable for publication? Redundancy should be minimized Grammar should be improved
GENERAL COMMENTS	The study has given theoretical recommendation, please focus on the present study.

VERSION 3 – AUTHOR RESPONSE

Reviewer: Dr. Bandana K Pradhan
1) Is the standard of written English acceptable for publication?
2) Redundancy should be minimized
3) Grammar should be improved
4) The study has given theoretical recommendation, please focus on the present study

According to these comments, we tried again to minimize our unnecessary redundant descriptions in the discussion section. We arranged our conclusion and policy implication so that they focused more on the present findings. Moreover, we have got a detailed native check from an English editing agency that was different from the last agency we used. I attached the certification of English quality check issued by the agency. The followings are the main parts we modified in the text.

Page 6, Line 21-23 to Page 7, Line 1-14 (Introduction)
In 2008, a national policy document14 stressed the importance of improving the health status of Nepal's urban population by providing a sustainable water supply and adequate sanitation. In the greater Kathmandu region, Kathmandu Upatyaka Khanepani Limited (KUKL) is responsible for supplying improved water, and in 2010 KUKL covered 79% of the population in that region.15 Although this met the MDGs for population coverage with safe water,16 the service provided by KUKL has not been formally assessed in terms of individual health. Evaluating the association between water sources, access to the amount of water, and the possibility of developing diarrhoea, particularly diarrhoeal disease, is critical in planning future public health interventions.
The aims of this study were as follows: (1) to evaluate the impact of access to water in terms of quality (water provided by KUKL or obtained from alternative sources, such as wells, stone spouts and springs) and quantity (daily quantity available per capita) on the risk of diarrhoea; (2) to identify the quantity of improved (i.e. KUKL-provided) or alternative water that is necessary to prevent diarrhoea. In addition, to identify vulnerable populations for access to water, we evaluated the association between socioeconomic status and diarrhoea.

Page 11, Line 1-11 (Method)
The demographic characteristics of the households evaluated included age of the household head, family size and number of individuals per room. Socioeconomic status included the following: ethnicity (Brahmin/Chhetri/Thakuri, Newar, Janajati or Dalit); occupation of the household head (white-collar occupation—service, business, house rental; blue-collar occupation—agriculture, manual labour or other; living from remittances; student; self-employed; and other); monthly household income (<5,000,

5,000−15,000 or >15,000 Nepalese rupees); and highest educational level attained by the household head (no education/primary education; secondary education; or college graduate or higher). In Nepal, ethnicity is related to caste, and it exists in addition to traditional social class categories; some ethnicities, such as Dalit, are often disadvantaged in many aspects.

Page 12, Line 15-21 (Result)
Regarding water sources, 26.2% of the households used KUKL-provided improved water only; 53.3% used both KUKL-provided and alternative water sources; and 20.5% used alternative water sources only. With respect to the total quantity of water consumption, 14.2% of households consumed 100 l/c/d or more of water; 28.9% households consumed less than 20 l/c/d. Households with basic (≥20 l/c/d) and intermediate (≥50 l/c/d) access to KUKL-provided improved water accounted for 29.1% and 11.6%, respectively.

Page 14, Line 2-6 (Result)

ORs for contracting diarrhoea among households without optimal access to improved water tended to be higher than those with full access (≥100 l/c/d); however, the ORs were less than or equal to 1 when the association between improved water access and diarrhoea was tested using alternative thresholds (i.e. 50 l/c/d or 20 l/c/d).

Page 14, Line 8-21 to Page 15, Line 1-6 (Discussion)

The results of this study indicate that although using alternative water sources in addition to improved water was associated with a higher risk of diarrhoea than using only improved water, limited access to water in terms of quantity (i.e. less than the WHO-recommended optimal amount of 100 l/c/d)—regardless of the source—was strongly associated with developing diarrhoea. Disadvantaged socioeconomic status—particularly lower income level, poor educational level of the household heads and Dalit ethnicity—were also independently associated with a high likelihood of having diarrhoea. Based on these findings, priority should be given to securing access to sufficient quantities of water (≥100 l/c/d) rather than limited access to improved water.8 The lack of water impedes personal hygiene, such as washing, resulting in bacterial accumulation on the skin.

Our findings demonstrate that households with partial access to improved water were at a greater risk of diarrhoea than those with full access. There are two possible explanations for this result. First, in households with partial access to improved water, the supply may have been intermittent. In that situation, water contamination in the distribution network becomes more likely owing to absorption of outside contaminants as a result of low pipe pressure.21 Second, residents in areas with intermittent access to improved water services may overestimate the reliability of the water and treat it inadequately. For example, having an intermittent water supply requires users to store water, which increases the risk of contamination.

Page 17, Line 8-12 (Conclusion)

In this study, only 14.2% households consumed the optimal amount of water. Hence, in Kathmandu Valley, sustainable alternatives for securing sufficient water supply should be explored and promoted. Furthermore, when advancing these interventions, socioeconomic disparities in accessibility to safe water also have to be carefully considered.