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RESEARCH ARTICLE

REVISED Knowledge on hypertension in Myanmar: levels and groups at risk

[version 2; peer review: 2 approved]

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Abstract

Background: Non-communicable diseases, specifically the burden of hypertension, have become a major public health threat to low- and middle-income countries, such as Myanmar. Inadequate knowledge of hypertension and its management among people may hinder its effective prevention and treatment with some groups at particular increased risks, but evidence on this is lacking for Myanmar. The aims of this study were therefore to assess the level of knowledge of risk factors, symptoms and complications of hypertension, by hypertension treatment status, community group-membership, and sociodemographic and socioeconomic factors in Myanmar.
Methods: Data was collected through structured questionnaires in 2020 on a random sample of 660 participants, stratified by region and existence of community groups. Knowledge of hypertension was measured with the 'Knowledge' part of a validated 'Knowledge, Attitude and Practice' survey questionnaire and categorised into ill-informed and reasonably to well-informed about hypertension.
Results: The majority of respondents seem reasonably to well-informed about risk factors, symptoms and complications of hypertension. This did not vary by hypertension treatment status and community group membership. People with jobs (B=0.96; 95%-confidence interval 0.343 to 1.572) and higher education (B=1.96; 0.060 to 3.868) had more hypertension knowledge than people without jobs or low education. Adherence to treatment among hypertensive people was low.
Conclusion: This study shows a majority of participants in this study in Myanmar seem reasonably to well-informed, with no differences by

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hypertension status, treatment status, and community group-membership. People without jobs and low education have less hypertension knowledge, making them priority groups for tailored education on health care level as well as community level, lowering the burden of hypertension. Almost half of the hypertensive patients did not take their medicines and therefore, adherence to treatment of hypertension should be an important element for future health education.

Keywords
Community health, Community-member, health literacy, Non-communicable diseases, health promotion, knowledge, hypertension, health behaviour



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REVISED **Amendments from Version 1**

Based on the comments and suggestions of the reviewers we have clarified our results and findings. We have revised the abstract and provided a framework of behaviour and adjusted the order of paragraphs in the Introduction. We also provided more contextual information about the included regions in the methods. Moreover, we stratified the educational variable based on the national census and provided more detailed information about our analysis and the results. Further, we have provided more information about the limitations of this study and attenuated our discussion.

Any further responses from the reviewers can be found at the end of the article

Plain language summary

Non-communicable diseases, specifically the burden of hypertension, have become a major public health threat to low- and middle-income countries, such as Myanmar. Inadequate knowledge of hypertension and its management among people may hinder its effective prevention and treatment. Socioeconomic and demographic factors, such as age and gender, have been suggested influencing level of knowledge, but evidence on this assumption lacks for Myanmar. Based on the findings in this research a training programme will be designed for community program volunteers and primary healthcare workers in Myanmar with special attention for informing vulnerable group members: people with low socioeconomic status and low health literacy. In the training programme, hypertension as chronic disease will be emphasised. In addition, the importance of adherence to treatment and how to influence that, will be high on the agenda. A cultural and contextual sensitive approach will be adopted for training in the community program, taking cognisance of local beliefs and customs. Health workers will be trained in motivational interviewing and counselling. Implementing these activities in the community programs, combined with training of healthcare staff, could lead to health gains and better cooperation and synergy between healthcare and community programs.

Introduction

Non-communicable diseases (NCDs) are the leading cause of morbidity and mortality worldwide, also in low- and middle-income countries (LMIC), such as Myanmar[1]. Myanmar is a country in transition with sociodemographic changes, urbanisation and industrialisation[2,3]. In Myanmar, unhealthy behaviour is becoming more common, *i.e.* smoking, eating processed foods, and a sedentary lifestyle, which are risk factors for developing NCDs[4]. Specifically, the burden of hypertension has become a major public health issue[5,6]. In Myanmar, in 2016, high blood pressure among adults was found in 22% of females and 23% aged 15 years and older[7].

Healthy behaviour contributes to prevention and control of hypertension and other NCDs, and knowledge is one of the preconditions for healthy behaviour[8]. According to the Theory of Reasoned Action knowledge is complemented by intentions, attitudes, subjective norms and beliefs, leading to healthy behaviour[9]. Understanding the determinants of health behaviours, *e.g.* as described by the Theory of Reasoned Action[9], may provide insights for targeting prevention. According to this theory, behaviour is predicted best by intentions, attitudes, subjective norms and beliefs. In turn, attitudes and subjective norms are established by behavioural, normative and control beliefs, which are based on knowledge. Critical health literacy, *i.e.* the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions, determines how well people are able to translate knowledge into appropriate (health-) behaviour[10,11]. According to the socio-ecological model, health behaviour is also determined by the social, physical and policy environment in which it occurs[12,13]. Socio-demographic factors influence the knowledge of diseases and risk factors, therefore behaviour[14–17]. Higher socioeconomic status and younger age are associated with a higher level of knowledge[18,19]. Having hypertension is also associated with improved knowledge of the disease[20–22]. In addition, if patients are aware of medication-use, physical activity and diet, they a more able to self-manage and prevent complications. It is also known that communication between physicians and hypertensive patients can improve knowledge of treatment and management of hypertension[23]. Moreover, diagnosis of a disease leads to health seeking behaviour, i.e. searching for additional information and help beyond the medical consultation[24].

In Myanmar, community-based groups, known as Inclusive Self-help Groups (ISHGs) aim to improve the wellbeing of vulnerable groups, such as people at risk for hypertension or with diagnosed hypertension. Community members support each other in improving livelihoods, social welfare, protection, health and care[25]. There are over 150 of such groups in Myanmar and the research project Scaling-Up NCD Interventions in South East Asia (SUNI-SEA) investigates possibilities to strengthen prevention of hypertension and diabetes through these groups[26]. Understanding hypertension knowledge among community group-members can help adapt interventions in these groups in order to increase effective prevention and control of hypertension.

To date, research about factors that influence the level of knowledge about hypertension is scarce in Myanmar. In order to set priorities for strengthening knowledge of hypertension in Myanmar, this explorative study assesses: 1) the level of knowledge of risk factors, symptoms and complications of hypertension and 2) whether this knowledge differs between hypertensive patients and non-patients and between community group-members or non-members, and by sociodemographic and socioeconomic factors.

Methods

Study design and sample

We analysed cross-sectional survey data collected in Myanmar (n=660), from community group-members (n=102) and non-members (n=558). The survey was conducted before the recent political changes. The sampling method was a stratified random sampling in three regions: Yangon (nine ISHGs), Mandalay (32 ISHGs) and Ayeyarwaddy (34 ISHGs). All three regions are located in the centre of Myanmar. The Yangon region is most

populated, with over seven million people. It is an ethnically diverse region, with different religions and the primary economical source of livelihood is trade. The Mandalay region is the second most populated region, with around 6.2 million people and over 95% of the population being Buddhists and with agriculture being the primary source of livelihood. The Ayeryarwady region is the most rural region, with 6.5 million people and 92% being Buddhists. Agriculture is the main source of livelihoods. Outside the main cities of Yangon and Mandalay educational opportunities are limited, with only 13% of the primary school students reaching high school. In Myanmar, 46% of women and 52% of men have attended secondary school at maximum and 10% of women and 7% of men have completed more than secondary education[27]. Per region, two villages, one with ISHGs and one without ISHGs, were included. Geographically, the Yangon region townships were urban, and the townships in Ayeyarwady and Mandalay were rural. Per village, 55 participants were included, aged 40 years and older, resulting in 220 participants per region and 660 participants in total. In villages with an ISHG, both members and non-members were included. The study population included both males and females, residing in the study area for at least six months.

Procedure

Data were collected in January 2020 door-by-door, by interviewers using tablets with data collection and processing software KoBo[28]. Trained enumerators collected data using structured questionnaires, including questions on lifestyle factors, knowledge and perception on hypertension, practices related to hypertension, and accessibility to healthcare services provided by ISHGs. The interviews started with open questions per topic. If the participant did not provide an answer, data collectors started probing, *i.e.* asking related questions, leading to better understanding of the questions and more relevant answers. Participation in the surveys was voluntary and informed consent was obtained from all participants before any data was collected. Ethical approval for the primary study was obtained from the Institutional Review Board (IRB) of the Department of Medical Research (DMR) of the Ministry of Health in Myanmar, under IRB number 2019-137 and approval number Ethics/DMR/2019/145.

Measures

Background, sociodemographic and socioeconomic variables regarded *gender (male=0 and female=1)*, *marital status* (not married=0 and married=1), *job status* (not-working=0 and working=1), *living area* (rural=0 or urban=1) and *age*, which we recoded into younger (=0) and older (=1) using the median as cut-off point. We dichotomized age because it had a skewed distribution and dichotomizing provides more power. *Education level* was measured by asking the participants to indicate what the highest level of completed schooling was. Answers were categorised into no education (=0), consisting of no formal schooling, low/middle education (=1) consisting of primary school level and secondary school level and high education (=2), consisting of high school level, college/university level and graduate.

Knowledge of hypertension was measured with the 'Knowledge' part of a validated 'Knowledge, Attitude and Practice' questionnaire[29] (see Extended Data file 1 for all knowledge questions). Respondents were asked to indicate whether an item concerning general knowledge of hypertension, risk factors, symptoms and complications was 'true' or 'false'. For example, 'risk factors for hypertension are the following: smoking, alcohol drinking, ageing, diabetes, high cholesterol, stress, pregnancy, sleep apnoea, poor diet, obesity or overweight, lack of physical exercise and family history of hypertension'. Knowledge was measured on four topics (see Figure 1 for the items per topic): general knowledge, risk factors, symptoms, and complications. All items (n=31) could be answered with true (=1) or false/do not know (=0). All items together created an overall knowledge variable for hypertension. A continuous variable on hypertension knowledge was created including scores from 0 to 31. A dichotomized variable was created based on cut-offs for knowledge level derived from similar other studies[30,31], namely: reasonably to well-informed (number of correct answers $\geq$ mean) or ill-informed (else). For six items, the percentage missing was higher than 10%[32]. To obtain approximately unbiased estimates of all parameters, we performed multiple imputation, based on all variables used for the analysis.

Hypertension was measured by asking participants if they had hypertension (self-reported) and if they took medicines for hypertension. This was categorised as hypertensive patients with treatment (prescribed medicine), hypertensive patients without treatment and non-patients. Moreover, hypertensive patients indicating not taking prescribed medicine were asked to give reasons for not taking medicine in an open question. *Community group-membership* was asked straightforwardly (no=0 or yes=1).

Analysis

First, we described the background characteristics of the sample. Second, we assessed the level of knowledge for risk factors, symptoms and complications. Third, we explored if hypertension treatment status, community group-membership, sociodemographic and socioeconomic factors were significantly associated with level of knowledge, using linear regression analyses, crude (univariate) and mutually (multivariate) adjusted. We assessed the associations with the four topics of hypertension knowledge and the overall knowledge of hypertension. To minimise potential bias, analyses were performed with the multiple imputed dataset, consisting of 10 data imputations, based on the assumption that the data was missing at random. In the imputed dataset, *e.g.* a pooled dataset based on 10 different plausible imputed datasets, all cases are preserved by replacing missing data with an estimated value based on the available information. A p value of <0.05 (two-tailed) was considered statistically significant for all

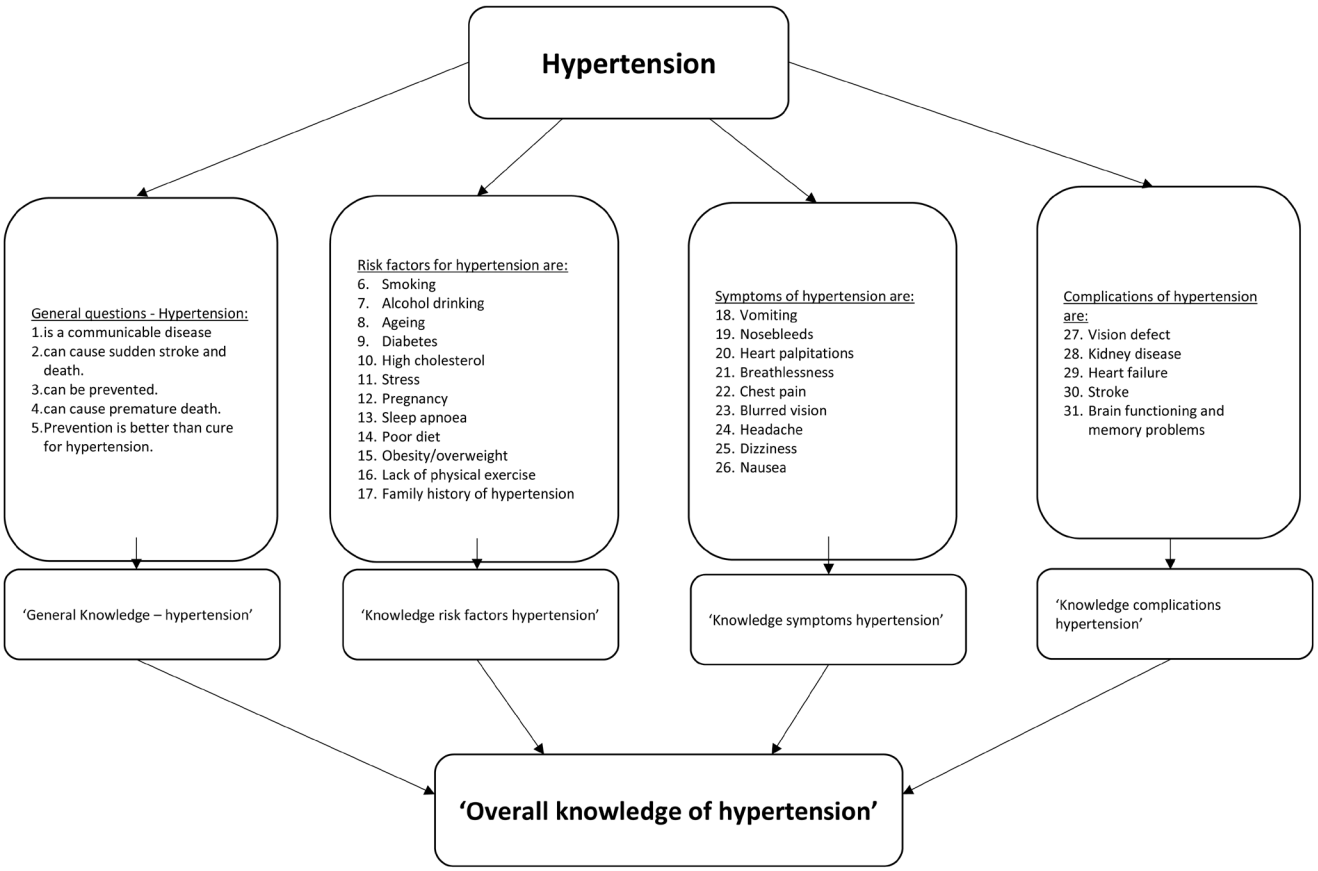


Figure 1. Illustration of recoding and development of knowledge variable.

associations. All measurements and analysis were carried out with IBM SPSS Statistics 26.

Results

Background characteristics

Table 1 shows the results of the descriptive analysis of the background characteristics of the sample population. In total, 179 (27%) men were included in the study with an average age of 57.5 (±10.7) years. Most respondents had a low or middle education level (64%), lived in a rural area (62%), were married (71%), indicated no community group-membership (84%) and were working (76%). Forty-five percent reported that they had hypertension and 175 respondents indicated taking medicine for hypertension. The most mentioned reasons by hypertensive patients for not taking medicines were '*feeling better*' and '*not having access to medication*'.

Level of knowledge of risk factors, symptoms and complications for hypertension

Table 2 shows rates of knowledge about hypertension for the total group and separately for hypertensive patients with treatment, patients without treatment, non-patients, community group-members and non-members. The majority of participants seem reasonably to well-informed about hypertension (88.2%). The proportion of reasonably to well-informed participants is highest among the group patients with treatment (91.4%) and lowest in the non-patients' group (86.5%).

The group patients with treatment scored on average highest on *knowledge about risk factors for hypertension* and the group of non-patients lowest (see Extended Data datafile 2 for the distribution of knowledge scores per subtopic). The group of hypertensive patients without treatment scored on average highest on *knowledge about symptoms of hypertension* and community group-members scored highest on *general knowledge about hypertension*.

Differences in the level of knowledge for hypertensive patients, community group-members and sociodemographic and socioeconomic factors

Hypertensive patients with and without treatment scored highest on knowledge of symptoms and complications. Community group-members scored lowest on knowledge of symptoms. Community group-members scored highest on knowledge of risk factors and non-patients the lowest without significant differences among groups.

The results of the linear regression analysis of the association of level of knowledge with sociodemographic and socioeconomic factors, hypertensive patients with treatment

and without treatment and community group-members is shown in Table 3, in which model 1 shows results for crude and model 2 for mutually adjusted analyses. In model 1 three sociodemographic and socioeconomic factors were associated with the level of knowledge, i.e., job status (B=1.07; 95%-confidence interval 0.505 to 1.631), educational level (B=1.85; 1.009 to 2.681) and age (B=-0.83; -1.268 to -0.400). This indicates that employed, higher educated and younger people have more hypertension knowledge than unemployed, lower educated and older people. In the adjusted model 2, job status (B=0.68; 0.062 to 1.295) and educational level (B=1.78; 0.884 to 2.669) were associated with level of hypertension knowledge, whereas age was not.

Table 1. Baseline characteristics of study population.

Characteristics study population (n=660)	Categories	n (%)
Gender	*Male*	179 (27)
	Female	481 (73)
Educational level[i]	*No education*	182 (28)
	Low/Middle education	424 (64)
	High education	54 (8)
Living area	*Rural*	406 (62)
	Urban	254 (38)
Marital status[ii]	*Married*	470 (71)
	Not married	188 (29)
Community group-members	*Member*	102 (16)
	Non- member	558 (84)
Job status	*Working*	501 (76)
	Non-working	159 (24)
Self-reported hypertension	*No*	364 (55)
	Yes	296 (45)
Taking medicine for hypertension[iii]	*No*	121 (41)
	Yes	175 (59)

[i] Missing = one person refused to answer
[ii] Missing = two persons refused to answer
[iii] Out of those with self-reported hypertension (n=296)

No significant associations were found in the knowledge scores between hypertensive patients with or without treatment or non-patients. In addition, no significant differences were found for community group-members or non-members. Last, no significant differences were found per subtopic of hypertension knowledge between hypertensive patients with and without treatment, and non-patients, and between community members and non-members.

Discussion

Based on our findings, it seems that most respondents in this study were reasonably to well-informed of risk factors, symptoms and complications regarding hypertension. No differences were found in level of knowledge between hypertension patients with or without treatment and non-patients and between community group-members and non-members. Employment and higher education level were positively associated with the level of hypertension knowledge.

We found that the majority of participants in the survey seem reasonably to well-informed about hypertension, which contrasts with findings of similar studies on hypertension knowledge in other Asian countries that show mainly poor hypertension knowledge[33,34]. A possible explanation for this finding could be the adoption of the WHO Package of Essential Non-Communicable (PEN) Diseases Interventions in Myanmar[35]. As part of the National Strategic Plan for Prevention and Control of NCDs (2017-2021)[36] the PEN was introduced in the whole country, aiming to strengthen health systems including health education among healthcare staff and citizens. The publicity around the PEN could have led to an improvement of hypertension knowledge in Myanmar.

Table 2. Distribution of ill-informed and reasonably to well-informed about hypertension among patients, non-patients, group-members and non-members.

Level of knowledge	All n (%)	Patients with treatment n (%)	Patients without treatment n (%)	Non-atients n (%)	Community group-members n (%)	Non-members n (%)
Mean ± stdev[i]	19.7±5.8	20.0±5.3	20.3±5.7	19.3±6.1	19.7±5.7	19.7±5.8
Ill-informed	78 (11.8)	15 (8.6)	13 (10.7)	49 (13.5)	11 (10.8)	66 (11.8)
Reasonably to well-informed	582 (88.2)	160 (91.4)	108 (89.3)	315 (86.5)	91 (89.2)	492 (88.2)
Total	660 (100)	175 (100)	121 (100)	364 (100)	102 (100)	558 (100)

[i]Mean and standard deviation of all 31 knowledge items

Table 3. Differences in level of knowledge[a]: results of regression analyses leading to regression coefficients (B) and 95%-confidence intervals.

Socio-demographic factors	Model 1[b] B(95% CI)	Model 2[c] B(95% CI)
Marital status (married vs. not married)	-0.51(-1.375;-0.365)	0.40(0692;1.496)
Educational level[d]	1.85(1.009;2.681)**	1.78(0.884;2.669)*
Gender (female vs. male)	0,12(-0. 923;1.160)	0,07(-1.005;1.135)
Living area (urban vs. rural)	-0.30(-1.285;0.695)	-0.77(-1.794;0.259)
Age (old vs. young)	-0.83(-1.268;-0.400)**	-0.42(-0.929;0.080)
Job-status (working vs not-working)	1.07(0.505;1.631)**	0.68(0.062;1.295)*
Hypertensive and community group-member		
Patients with treatment	0.73(-0.340;1.799)	1.06(-0.046;2.170)
Patients without treatment	1.12(-0.127;2.356)	0.97(-0.272;2.206)
Community group-members	0.01(-1.241;1.262)	-0.10(-1.575;1.368)

[a] Included in the analyses is the continuous variable of level of knowledge, with scores between 0-31

[b] Crude variables analyses: univariate regression of hypertension knowledge and independent variable

[c] Variables mutually adjusted analysis: multivariable regression of hypertension knowledge and independent variables including all *potentially confounding variables* included in this model.

[d] Educational groups: no education, low/middle education, high education

* Significant by p<0.05 ** significant by p<0.01

Another explanation for finding that the majority of participants in this study was reasonably to well-informed about hypertension, might be that we dichotomized hypertension knowledge based on the mean score as a cut-off point. Although the cut-off was derived from similar studies, dichotomizing knowledge could have led to overestimation of knowledge levels. In Myanmar, no comparative results regarding hypertension knowledge exist and therefore no validated estimate could be drawn for our study.

We found no differences in knowledge between hypertensive patients and non-patients, and neither between patients that took hypertension medication and patients that did not. This contrasts with evidence from other research were patients showed to have more knowledge about their illness[37]. This may be explained by insufficient communication between health workers and patients in the research areas in this study in Myanmar[38–41]. It is known that the capacities of human resources for health in Myanmar are limited[42]. The training of health workers is not covering NCDs as a topic, and only since the introduction of the PEN programme on-the-job training was introduced. In rural areas in Myanmar, healthcare coverage is inadequate and healthcare workers do not have time for communication about NCDs and risk factors[42].

Furthermore, we found that over 40% of the hypertensive patients reported not taking their prescribed medicines. Non-adherence to antihypertensive drugs can have adverse health outcomes, such as stroke and kidney damage[43,44]. Several factors may contribute to non-adherence. First, patients may not feel the urgency to adhere to treatment for a longer period of time[45]. Patients show poor treatment follow-up even after the initial consultation[35]. Long travelling times or unavailability of medicine may contribute to poor adherence[35].

Community Inclusive Self-help Groups (ISHGs) members did not have better knowledge. This is not in line with previous research, which showed health promotion activities in community-based programs being effective in improving health-related knowledge and healthy behaviour[46–48]. An explanation for this finding may be that the community groups had not yet undertaken as many health activities in relation to prevention of NCDs.

Finally, we found that job-status and educational level were associated with the level of knowledge, which confirms evidence from other LMIC[17,18]. People with a lower socioeconomic status have a lower level of hypertension knowledge, which makes them more vulnerable to hypertension. Low educational

level is also associated with limited health literacy[49], which can result in disadvantageous health outcomes.

Strengths and limitations

Strengths of this study are the comprehensiveness of the data that was collected, including multiple sociodemographic and socioeconomic factors, variables about hypertension knowledge, covering different geographical areas in Myanmar. Another strength is the stratified random sampling method, which ensured each area was adequately represented within the whole sample population of this study.

A limitation of this study is the unknown response rates, combined with a reasonable number of missing values. We solved this by multiple imputation, creating several different plausible imputed datasets and combining the results. Another limitation of the present study is the method of measuring knowledge of hypertension in the questionnaire. All items for general knowledge, risk factors, symptoms and complications were positively formulated, which is commonly done in KAP-surveys. This could have resulted in response bias. Furthermore, in this study we used self-reported hypertension and use of medication for hypertension. Inadequate self-reporting could have led to underestimating the actual number of hypertensive patients and the medication adherence. Moreover, this is a relatively small size study, which may have resulted in finding mainly the strongest associations. Last, in this study selection bias may have occurred, taking into considering the inclusion of a vast majority of female participants. Because data was collected during the daytime, most men were working. Even with these limitations, this is one of the few studies, to our knowledge, that report on the level of hypertension knowledge and differences in hypertension knowledge between hypertensive patients, non-patients, community group-members and non-members in Myanmar.

Implications

The research was carried out in the context of project 'Scaling Up Non-communicable diseases Interventions in South East Asia' (SUNI SEA; 2019-2022). Based on the findings in this research a training programme will be designed for ISHG volunteers and primary healthcare workers. There will be special attention for informing vulnerable group members: people with low socioeconomic status and low health literacy. In the training programme, hypertension as chronic disease will be emphasised. In addition, the importance of adherence to treatment will be high on the agenda. A cultural and contextual sensitive approach will be adopted for training ISHGs, taking cognisance of local beliefs and customs. Health workers will be trained in motivational interviewing and counselling. Implementing these activities in the ISHGs, in combination of training healthcare staff, could lead to health gains and better cooperation and synergy between healthcare and community programs[46–48].

The findings of this study require conformation in a larger study. With improved data collection tools, sensitivity and power problems can be limited. Follow-up studies after training ISHGs are planned in the SUNI-SEA project, which could measure differences in knowledge as result of the training.

Conclusion

This study showed that the majority of participants in the study in Myanmar seem reasonably to well-informed of risk factors, symptoms and complications concerning hypertension, with no differences between hypertensive patients and non-patients, and no differences between community group-members and non-members. Unemployed and lower educated people have less hypertension knowledge, indicating them as priority groups for health education. Increasing knowledge of hypertension and its management among people will enhance prevention and treatment. This study guides the interventions in this regard in Myanmar. Thus, we suggest implementing health-related activities at community level and improving health-related education at the primary healthcare level. In order to effectively lower the burden of hypertension, synergies between community programmes and primary healthcare should be implemented.

List of abbreviations

e.g.: exempli gratia, Latin phrase meaning "for example"

HL: health literacy

FHL: functional health literacy

i.e.: id est, Latin phrase meaning "that is".

ISHG: Inclusive Self-help Groups

NCD: non-communicable disease

Ethics and consent

Ethicals approval for the primary study was obtained from the Institutional Review Board (IRB) of the Department of Medical Research (DMR) of the Ministry of Health in Myanmar, under IRB number 2019-137 and approval number Ethics/DMR/2019/145.

All patients gave written and oral informed consent to participate in the study before taking part.

Data availability

Underlying data

Zenodo: Underlying data for 'Knowledge on hypertension in Myanmar: levels and groups at risk'. https://doi.org/10.5281/zenodo.5880978

Extended data

1. **Zenodo: Extended data for 'Knowledge on hypertension in Myanmar: levels and groups at risk'. https://doi.org/10.5281/zenodo.5881186**
2. **Zenodo: Extended data for 'Knowledge on hypertension in Myanmar: levels and groups at risk'. https://doi.org/10.5281/zenodo.7670240**

Reporting guidelines

Zenodo: STROBE checklist for 'Knowledge on hypertension in Myanmar: levels and groups at risk'. https://doi.org/10.5281/zenodo.5881253

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Authors' contributions

Authors KHS and HHW were involved in the preparation and data collection. Authors ZP, JAL, CS and RL conceptualized the study. Author ZP led the protocol and data analysis with a significantly contribution of the authors JAK, JAL, RPF, HTMH and CS. Author ZP wrote the initial draft of the manuscript, produced the tables and incorporated contributing author feedback into the paper. JAL, SAR, RL, JAK and MJP contributed to all drafts and manuscript. All authors provided feedback on drafts. All authors read and approved the final manuscript.

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Open Peer Review

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Version 2

Reviewer Report 04 April 2023

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✔ **Martin Heine**
Department of Global Public Health & Bioethics, Julius Centre for Health Sciences and Primary Care, University Medical Centre Utrecht, Utrecht, The Netherlands

Thank you for addressing the comments provided, and congratulations on an important study for the management and prevention of HTN in Myanmar.

For future research, you could consider developing more adequate cut-off value for HTN knowledge in relation to risk or clinical outcomes as I do feel that the current dichotomisation is still a bit unsatisfactory; however, this is also clearly mentioned now in the limitations section.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: non-communicable disease, global health, implementation science

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 06 February 2023

https://doi.org/10.21956/openreseurope.15559.r30796

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? **Martin Heine**

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Introduction:
There are many theories that aim to explain behavior, of which the Theory of reasoned action is one. It is not clear why specifically this theory was adopted for understanding prevention and control of HTN in Myanmar; specifically, as this theory largely "excludes" eccentric/environmental factors that inform behavior. For example, we have shown that for physical activity, a more holistic approach would be needed to fully grasp PA behavior when settings with limited resources are concerned (Heine *et al.*, 2021[1]). A framework of behaviour that is more response to contextual factors, may also aid the introduction (and selection) of the variables of interest you specifically looked at (e.g., socio-economic status).

In the second to last paragraph you mention that you will look at "community-members" and non-members, however, at that stage, the concept of the ISHG's has not been introduced, hence, it is not clear what "community" you refer to.

Methods:
Study settings and sample:

- Would you be able to provide a bit more detail on the context for each village or region? This will be helpful in interpreting the findings. For example, the CICI framework (Pfadenhauer *et al.*, 2017[2]) provides an overview of different contextual factors one could consider; and also our group (van Zyl *et al.*, 2021[3]) has provided some guidance and discussion as to the resources often challenged in low-resourced settings, and argue for a more in-depth interrogation on these when reporting study findings.

Procedure:

- Please provide detail on ethical approval.

Measures:

- Please provide a rationale for using the "median" as a way to dichotomize age? Given the mean age, would you really argue that someone e.g., 56 is a "younger" adult? Is there no better way of doing this (e.g., based on burden of disease, or more sub-groups)?

- Same for education level; is there a reason to dichotomize? Seems to me you lose nuances by doing so, e.g. higher education, in any country, would be a significant education upbringing, like to affect health seek-behaviour, disease knowledge etc. - this is now grouped with no education.

Hypertension:

- Ideally, one would also have collected objective measures for HTN, being the primary outcome. Working in South African low-resourced settings, we noticed for instance that quite a number of participants have been diagnosed with hypertension yet were unaware, or were receiving HTN medication, however could not explain what the medication they were taking was for (in particular in uneducated participants). Hence, this will impact validity

of self-reported measures of morbidity (in this case, hypertension). I would argue this should be included in the limitations section.

Analysis:

- Wouldn't this be considered logistic regression, seeing that you dichotomized the hypertension knowledge outcome?

- Dichotomization of HTN should be reconsidered. If all participants have very poor knowledge, then the mean score would be very low - having scored higher than the mean score, should then not lead to a conclusion that that specific participant is reasonably- to well-informed. Are there no validated cut-off points for this knowledge measure? Alternatively, one could either use IQRs, or treat the outcome as a continuous score between 0 – 31.

- Could you provide a bit more detail on the regression analyses done? I assume the crude analysis, is univariate? And the mutually adjusted is a multivariate analysis? Did you plan to include all variables in the adjusted analysis? Or just the ones that reach significant or explained a certain percentage of variance? etc. It is difficult to interpret your findings in this way.

Results:

- Please see earlier comment on grouping of education level. A 97% low-education is not surprising given your definition, plus, within the context of Myanmar, is e.g., having completed high school or higher education not considered quite an achievement (i.e. is this really "low" education, within the context of Myanmar?). I would really argue for stratifying the analysis in addition to subgroups for education, and using no formal education as a reference group (possibly in conjunction with those not completed elementary school). One could also look at a national census (if available for Myanmar) to see how they grouped education levels.

- Given the random sampling technique, can you explain the vast difference in male and female participation? This suggests selection bias, and should be acknowledged in the limitations section. It is also interesting in itself in relation to the prevention/treatment of HTN. What were the factors leading to the higher female inclusion (e.g., men at work, etc)?

- In your figure, detailing the various questions you highlight four "sub-scales"; is there value in presenting data for those as well? For instance, I would argue that it is less problematic if someone without hypertension knows about HTN complications, and its more important to know about risk factors? This could be an avenue to be explored to provide more depth to your analyses.

Discussion:

- Based on the analysis currently provided, the "main finding" presented in the first paragraph of the discussion seems the artefact of definition, rather than a "true" finding. E.g., 50% of your sample (assuming normal distribution) scored less than 19.7 out of 31.

References

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Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and does the work have academic merit?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: non-communicable disease, global health, implementation science

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 13 Mar 2023

Zinzi Pardoel

Thank you for your comprehensive review and detailed comments. We have clarified and revised the manuscript based on your comments. Please find a detailed response, preceded by [Response] to all comments.

Introduction:
1. There are many theories that aim to explain behavior, of which the Theory of reasoned

action is one. It is not clear why specifically this theory was adopted for understanding prevention and control of HTN in Myanmar; specifically, as this theory largely "excludes" eccentric/environmental factors that inform behavior. For example, we have shown that for physical activity, a more holistic approach would be needed to fully grasp PA behavior when settings with limited resources are concerned (Heine et al., 20211). A framework of behaviour that is more response to contextual factors, may also aid the introduction (and selection) of the variables of interest you specifically looked at (e.g., socio-economic status).

[Response 1] Thank you for your suggestion. We agree and have now introduced another framework of behaviour, i.e., the socio-ecological model, in the introduction. The revised text is (new text has been italicized): *"According to the socioecological model, health behaviour is also determined by the social, physical and policy environment in which it occurs[1]. Socio-demographic factors influence the knowledge of diseases and risk factors, therefore behaviour." [1] Stokols D. Translating social ecological theory into guidelines for community health promotion. Am J Health Promot. 1996;10(4):282–98. [2]. Heine, M., Badenhorst, M., van Zyl, C., de Melo Ghisi, G. L., Babu, A. S., Buckley, J., … Derman, W. (2021). Developing a Complex Understanding of Physical Activity in Cardiometabolic Disease from Low-to-Middle-Income Countries—A Qualitative Systematic Review with Meta-Synthesis. International Journal of Environmental Research and Public Health, 18(22). https://doi.org/10.3390/ijerph182211977* 2.

In the second to last paragraph you mention that you will look at "community-members" and non-members, however, at that stage, the concept of the ISHG's has not been introduced, hence, it is not clear what "community" you refer to.

[Response 2] Thank you for comment. We have clarified this by revising the last paragraph and rearranging the order of the paragraphs. The last paragraph is now the second last paragraph. The revised text is (new text has been italicized): *"In Myanmar, community-based groups, known as Inclusive Self-help Groups (ISHGs) are aimed to improve the wellbeing of vulnerable groups, such as people at risk for hypertension or with hypertension.* Community members support each other in improving livelihoods, social welfare, protection, health and care."

Methods: Study settings and sample: 3. Would you be able to provide a bit more detail on the context for each village or region? This will be helpful in interpreting the findings. For example, the CICI framework (Pfadenhauer et al., 20172) provides an overview of different contextual factors one could consider; and also our group (van Zyl et al., 20213) has provided some guidance and discussion as to the resources often challenged in low-resourced settings, and argue for a more in-depth interrogation on these when reporting study findings.

[Response 3] We have added some more contextual information about the regions to the Methods section, namely: *"All three regions are located in the centre of Myanmar. The Yangon region is most populated, with over seven million people. It is an ethnically diverse region, with different religions and the primary economical source of livelihood is trade. The Mandalay region is the second most populated region, with around 6.2 million people and over 95% of the*

population being Buddhists and with agriculture being the primary source of livelihood. The Ayeryarwady region is the most rural region, with 6.5 million people and 92% of the population being Buddhists. Agriculture is the main source of livelihoods."

Procedure: 4. Please provide detail on ethical approval.

[Reponse 4] We have added the information on the ethical approval of the primary data collection to the procedure, based on your suggestion, namely: *"Ethics approval for the primary study was obtained from the Institutional Review Board (IRB) of the Department of Medical Research (DMR) of the Ministry of Health in Myanmar (IRB number 2019-137 and approval number Ethics/DMR/2019/145)."*

Measures: 5. Please provide a rationale for using the "median" as a way to dichotomize age? Given the mean age, would you really argue that someone e.g., 56 is a "younger" adult? Is there no better way of doing this (e.g., based on burden of disease, or more sub-groups)?

[Response 5] Our rationale for using the median to dichotomize age is a skewed distribution of age (40 -87 years) and dichotomizing provides more power in the analysis. We have added text to clarify this, namely: *"and age, which we recoded into younger (=0) and older (=1) using the median as cut-off point. We dichotomized age because it had a skewed distribution and dichotomizing provides more power."*

6. Same for education level; is there a reason to dichotomize? Seems to me you lose nuances by doing so, e.g., higher education, in any country, would be a significant education upbringing, like to affect health seek-behaviour, disease knowledge etc. - this is now grouped with no education.

[Response 6] Based on your suggestion, we categorized the variable into no formal education, low/middle education and high education. We have looked at the national census. We have added the following text under study design: *"Outside the main cities of Yangon and Mandalay educational opportunities are limited, with only 13% of the primary school students reaching high school. In Myanmar, 46% of women and 52% of men have attended secondary school at maximum and 10% of women and 7% of men have completed more than secondary education[2]."* [2] *MOHS, ICF. Myanmar Demographic and Health Survey 2015-16. Myanmar Demogr Heal Surv [Internet]. 2017;1–37. Available from: https://dhsprogram.com/publications/publication-fr324-dhs-final-reports.cfm%0Ahttps://dhsprogram.com/pubs/pdf/FR324/FR324.pdf*

7. Hypertension: Ideally, one would also have collected objective measures for HTN, being the primary outcome. Working in South African low-resourced settings, we noticed for instance that quite a number of participants have been diagnosed with hypertension yet were unaware, or were receiving HTN medication, however could not explain what the

medication they were taking was for (in particular in uneducated participants). Hence, this will impact validity of self-reported measures of morbidity (in this case, hypertension). I would argue this should be included in the limitations section.

[Response 7] We agree that self-reported hypertension can impact the validity of measuring. We have added a comment on potential information bias due to self-reported hypertension and medication use to the limitations part of the Discussion section, namely: "*Furthermore, in this study we used self-reported hypertension and use of medication for hypertension. Inadequate self-reporting could have led to underestimating the actual number of hypertensive patients and the medication adherence*."

Analysis: 8. Wouldn't this be considered logistic regression, seeing that you dichotomized the hypertension knowledge outcome?

[Response 8] We did our analyses with use of hypertension knowledge as a continuous variable. We therefore used a linear regression. We have provided some additional information to clarify this in the Methods section. The revised text is (new text has been italicized): "*A continuous variable on hypertension knowledge was created including scores from 0 to 31. A dichotomized variable was created based on cut-offs* for knowledge level derived from similar other studies [27, 28] , namely: reasonably to well-informed (number of correct answers ≥ mean) or ill-informed (else)." *[27] Kassahun CW, Mekonen AG: Knowledge, attitude, practices and their associated factors towards diabetes mellitus among non diabetes community members of Bale Zone administrative towns, South East Ethiopia. A cross-sectional study. PLoS One. 2017;12(2):e0170040. 28152066 10.1371/journal.pone.0170040 5289457 [28] Parmar P, Rathod GB, Rathod S, et al.: Study of knowledge, attitude and practice of general population of Gandhinagar towards hypertension. Int J Curr Microbiol App Sci. 2014;3(8):680–685.* Moreover, we clarified our use of a continuous variable by adding the following text to the footnote of Table 3 in the Results section: "[a] *The continuous variable of level of knowledge, with scores between 0-31, was included in the analyses*"

9. Dichotomization of HTN should be reconsidered. If all participants have very poor knowledge, then the mean score would be very low - having scored higher than the mean score, should then not lead to a conclusion that that specific participant is reasonably- to well-informed. Are there no validated cut-off points for this knowledge measure? Alternatively, one could either use IQRs, or treat the outcome as a continuous score between 0 – 31.

[Response 9] Thank you for pointing this out. First, we have based our cut-off for the knowledge level on similar studies measuring the knowledge part of the Knowledge, Attitude, and Practice-survey. In these studies[27,28], the mean score was used as cut-off for dichotomizing knowledge into 'Good knowledge' vs 'Poor knowledge'. We have dichotomized as 'reasonably to well-informed' vs 'ill-informed. The dichotomized knowledge variable is used for the describing levels of knowledge in different groups (e.g., married vs. not married).
Second, we used the outcome as a continuous score between 0 – 31 in the analyses. See our

response to your comment 8 for more clarification. [27] Kassahun CW, Mekonen AG: Knowledge, attitude, practices and their associated factors towards diabetes mellitus among non diabetes community members of Bale Zone administrative towns, South East Ethiopia. A cross-sectional study. *PLoS One.* 2017;12(2):e0170040. 28152066 10.1371/journal.pone.0170040 5289457 [28] Parmar P, Rathod GB, Rathod S, et al.: Study of knowledge, attitude and practice of general population of Gandhinagar towards hypertension. Int J Curr Microbiol App Sci. 2014;3(8):680–685.

10. Could you provide a bit more detail on the regression analyses done? I assume the crude analysis, is univariate? And the mutually adjusted is a multivariate analysis? Did you plan to include all variables in the adjusted analysis? Or just the ones that reach significant or explained a certain percentage of variance? etc. It is difficult to interpret your findings in this way.

[Response 10] In response to your question, we clarified this under table 3. The revised text is (new text has been italicized): "[b] Crude variables analyses: *univariate regression of hypertension knowledge and independent variable* [c] Variables mutually adjusted analysis: *multivariable regression of hypertension knowledge and independent variables including all potentially confounding variables included in this model.*"

Results: 11. Please see earlier comment on grouping of education level. A 97% low-education is not surprising given your definition, plus, within the context of Myanmar, is e.g., having completed high school or higher education not considered quite an achievement (i.e. is this really "low" education, within the context of Myanmar?). I would really argue for stratifying the analysis in addition to subgroups for education, and using no formal education as a reference group (possibly in conjunction with those not completed elementary school). One could also look at a national census (if available for Myanmar) to see how they grouped education levels.

[Response 11] Thank you for this suggestion. We have responded to this comment at your comment 6.

12. Given the random sampling technique, can you explain the vast difference in male and female participation? This suggests selection bias, and should be acknowledged in the limitations section. It is also interesting in itself in relation to the prevention/treatment of HTN. What were the factors leading to the higher female inclusion (e.g., men at work, etc)?

[Response 12] Based on your suggestion, we have added information about this selection bias in the limitation section, namely: *"Last, in this study selection bias may have occurred , taking into consideration the inclusion of a vast majority of female participants. Because data was collected during the daytime, most men were working."*

13. In your figure, detailing the various questions you highlight four "sub-scales"; is there

value in presenting data for those as well? For instance, I would argue that it is less problematic if someone without hypertension knows about HTN complications, and its more important to know about risk factors? This could be an avenue to be explored to provide more depth to your analyses.

[Response 13] Thank you for this suggestion. We have added results of average knowledge per subgroup as extended data. Moreover, we have added the following text: "*The group patients with treatment scored on average highest on knowledge about risk factors for hypertension and the group of non-patients lowest (see Extended Data datafile 2 for the distribution of knowledge scores per subtopic). The group of hypertensive patients without treatment scored on average highest on knowledge about symptoms of hypertension and community group-members scored highest on general knowledge about hypertension.*" We also analysed if there were significant differences per subtopic of knowledge between hypertensive patients vs non-patients and community members vs non-members. We have added the following text in the Results section: "*Last, no significant differences were found per subtopic of hypertension knowledge between hypertensive patients with and without treatment, and non-patients, and between community members and non-members*."

Discussion: 14. Based on the analysis currently provided, the "main finding" presented in the first paragraph of the discussion seems the artefact of definition, rather than a "true" finding. E.g., 50% of your sample (assuming normal distribution) scored less than 19.7 out of 31.

[Response 14] Although the cut-off for knowledge was derived from similar studies analysing the knowledge part of the KAP-questionnaire, we agree that dichotomizing knowledge based on the mean score could have led to overestimation of knowledge levels. In Myanmar, no comparative results regarding hypertension knowledge exist and therefore no validated estimate could be drawn for our study. We have revised the sentence describing this finding namely: "*Based on our findings, it seems that most respondents in this study were reasonably to well-informed of risk factors, symptoms and complications regarding hypertension."* Moreover, we have attenuated this conclusion by revising sentences which state that respondents *were* reasonably to well-informed into respondents *seem* to be reasonably to well-informed. We also added a discussion paragraph in which we put this finding up for discussion. The new text is: *"Another explanation for finding that the majority of participants in this study was reasonably to well-informed about hypertension, might be that we dichotomized hypertension knowledge based on the mean score as a cut-off point. Although the cut-off was derived from similar studies, dichotomizing knowledge could have led to overestimation of knowledge levels. In Myanmar, no comparative results regarding hypertension knowledge exist and therefore no validated estimate could be drawn for our study."*

Competing Interests: No competing interests were disclosed.

Reviewer Report 18 February 2022

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Good article. However the authors need to relook at the abstract. The results are quoted in the conclusion and they do not tally with the overall message. Those with poor education/no jobs have a greater chance of not taking medication and this is a social grouping. This is the only bit that needs to be sorted. However, in the manuscript the information is correctly documented.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and does the work have academic merit?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Hypertension, NCDs and HIV/AIDS

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 13 Mar 2023

Zinzi Pardoel

Thank you for treviewing our manuscript. We have carefully considered your comment and revised the manuscript accordingly. Please find a detailed response, preceded by [Response] to the comment. [Response] Thank you for your compliment and suggestion for revision of the abstract. We have clarified and revised the abstract based on your comment. We revised the following part (new text has been italicized): “People without jobs and low

education have less hypertension knowledge, making them priority groups for tailored education on health care level as well as community level, lowering the burden of hypertension. *Almost half of the hypertensive patients did not take their medicines* and therefore, adherence to treatment of hypertension should be an important element for future health education."

Competing Interests: No competing interests were disclosed.