Evaluating rural Ethiopian youths’ willingness and competency to be literacy builders for G x E influences on podoconiosis

Ayode, Desta, Engdawork, Kibur, Moore, Renee H, Tadele, Getnet, Davey, Gail and McBride, Colleen M (2023) Evaluating rural Ethiopian youths’ willingness and competency to be literacy builders for G x E influences on podoconiosis. PLoS Neglected Tropical Diseases. ISSN 1935-2735

This version is available from Sussex Research Online: http://sro.sussex.ac.uk/id/eprint/112218/

This document is made available in accordance with publisher policies and may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher’s version. Please see the URL above for details on accessing the published version.

Copyright and reuse:
Sussex Research Online is a digital repository of the research output of the University.

Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable, the material made available in SRO has been checked for eligibility before being made available.

Copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.

http://sro.sussex.ac.uk
Evaluating rural Ethiopian youths’ willingness and competency to promote literacy regarding G x E influences on podoconiosis

Desta Ayode, Kibur Engdawork, Renee H. Moore, Getnet Tadele, Gail Davey, Colleen M. McBride

*Department of Sociology, College of Social Sciences, Addis Ababa University, Addis Ababa, Ethiopia; aRollins School of Public Health, Emory University, Atlanta, GA, United States of America; cDepartment of Epidemiology and Biostatistics, Dornsife School of Public Health, Philadelphia, PA, United States of America; dBrighton and Sussex Medical School, University of Sussex, Falmer, Brighton, United Kingdom

*Corresponding author: Tel: +1 301- 452-7988 Email: colleen.marie.mcbride@emory.edu
Abstract

Introduction: Engaging youth as peer educators has yet to be considered in the context of promoting literacy concerning conjoint genetic and environmental (GxE) influences on health conditions. Whether youth living in Low and Middle Income Countries (LMICs) could and would be willing to serve as lay educators of GxE education is unclear.

Methods: A cross-sectional survey of youth living in Southern Ethiopia was conducted from August to September 2017. Trained data collectors administered the survey on 377 randomly selected youth who ranged in age from 15-24; 52% were female and 95% reported having some formal education. Self-reported willingness and a constructed competency score were assessed. Bivariate analyses tested for factors associated with willingness and competency to serve as lay GxE literacy builders.

Results: Competency and willingness were significantly greater (p<0.05) for youth who: were male, had some formal education, and had civic or leadership experience. Differences in median willingness were significant for youth who scored as more competent versus those who scored as less competent (p<0.001). There were no characteristics that moderated the association of competency with willingness.

Conclusion: Youth peer educator programs could hold promise for disseminating improved GxE literacy among LMICs. Thoughtful recruitment and training strategies will be needed to ensure that the broadest representation of youth have the opportunity to serve in this role, particularly girls and those without formal education.

Key words
Competency, Gene-environment interaction, Podoconiosis, Youth peer education, Willingness, Ethiopia
Introduction

Advances in genomic technologies and environmental exposure measurement (e.g., lifestyle, toxins, social determinants) have advanced our understanding that virtually all disease is jointly influenced by interactions of both genes with environment (GxE) [3-5]. Indeed, there are numerous ways that genetic predisposition interacts with environmental exposures to influence health outcomes (e.g., additive, multiplicative interactions; Belsky, Moffitt, Caspi, 2013; Boardman, Daw, Freese, 2013). For the purposes of this report, we consider G x E interactions broadly as occurring when the expression of a trait is influenced by the interplay of genes and the environment (https://www.genome.gov, accessed Feb 22, 2023). For example, environmental exposures can “turn” genes on and off in ways that increase or decrease health risks (Boardman et al., 2013). Moreover, genetic influences may only manifest in the presence of an environmental exposure. Thus, reducing or eliminating exposures is particularly beneficial for those who have inherited susceptibilities to a specific health condition.

Lay understanding of G x E interactions is low generally and even more so in communities with limited literacy[9]. Our prior work and that of others show that lay audiences commonly misperceive that genetic influences operate deterministically and therefore cannot be prevented [10, 11] [9, 12]. [16]. Promoting accurate understanding of G x E influences is important because beliefs about the causes of health conditions are associated with what if any precautionary actions are taken to reduce disease risk [13]. For example, beliefs that a health condition cannot be prevented are generally negatively associated with individuals taking any precautionary actions[14, 15].

G x E Influences and Podoconiosis:
Podoconiosis is a neglected tropical disease with confirmed genetic and environmental influences on its pathogenesis [28]. The disease is caused by bare feet exposure to the red clay soils of volcanic areas [28-30]. Recent nationwide mapping in Ethiopia suggests the overall disease prevalence is 4% [18]; 43% of the population is at risk [34]. Our research was conducted in Wolaita Zone of southern Ethiopia where 1 in 20 people are estimated to be affected by the condition [29, 35]. Podoconiosis poses substantial socio-economic burden particularly to subsistence farmers in Ethiopia who routinely work barefoot. Individuals who develop the condition experience progressive bilateral swelling of the lower legs, oozing wounds with an offensive odor [29, 31], and physical disfigurement. Affected individuals often experience social and self-stigma that excludes them from social activities, and marital relationships with members of unaffected families [37, 38, 39] [42, 43].

The condition clusters among families [63% heritability; Davey 2 articles]. Genome-wide association testing has identified variations at the HLA class II locus on chromosome 6 – that influences immune response is associated with increased risk for developing podoconiosis [Ayele...Davey, NEJM, 2012]. However, the condition is entirely preventable if genetically high-risk individuals consistently protect their feet by wearing shoes and practicing foot hygiene[36, 37].

**Interventions to Promote Shoe Wearing in Rural Ethiopia**

Our research team has been working for over a decade with communities in the Wolaita district of southern Ethiopia [28]. In a series of qualitative studies, we have found that both affected and unaffected individuals acknowledge that podoconiosis runs in families [[57] 58, 59]. However, this understanding is counterbalanced by beliefs that the condition also is contagious, which may explain the clustering of cases [REF]. [36, 37]. Community members believe the
condition can be passed by sharing shoes, bath water, and other activities of close proximity with someone who is affected. We found this belief also to be associated with strong external and internal stigma and less inclination to endorse shoe-wearing and foot hygiene as effective for prevention [REF].

Based on these findings we conducted a randomized community-based intervention trial described in detail elsewhere [McBride, Price et al, 2015]. We tested in a three-arm design with all arms receiving general activities to raise community awareness [e.g., posters at the local markets] and in two arms, affected and neighboring households received a home-based session provided by adult lay health workers to promote shoe-wearing and foot hygiene. In addition, in the third arm, households received education on the process by which G x E influenced podoconiosis and its amenability to prevention. We found that unaffected neighbors who received the G x E education were significantly more likely to self-report decreased levels of stigma against their affected neighbors [17,18]. Based on these findings, we began to test sustainable dissemination avenues for this education as described below.

**Youth as Effective Disseminators of Health Education**

Engaging youth has been shown consistently to be effective for disseminating health messages on sensitive issues and expanding reach of health-related services [25, 26, 20, 21-24][27] [44, 45]. Numerous studies in LMICs show that youth-led education interventions can reduce youth’s risky sexual behaviors, violence and substance use [47, 48], and reproductive health knowledge [49].

To be effective at building genomic literacy, youth would need to be open to the notion that genetic influences are not deterministic of health outcomes. To this end, we surveyed youth in the Wolaita district of southern Ethiopia to assess their understanding of G x E contributors to
podoconiosis [Engdawork et al., 2018]. Half of the youth surveyed accurately endorsed the joint contributions of gene and environment influences on podoconiosis and that the condition could be prevented. However, many youth also held misconceptions about contagion that could reduce their competence as lay educators.

**Assessing Competency of Youth Lay Educators**

Surprisingly, the majority of studies of lay peer educator have not described or assessed the requisite qualities that influence youth competent to serve as lay educators (Rath et al., 2020; Tang et al., 2022; Shankar et al., 2020). One systematic review of school-based peer education interventions suggested that the most effective peer-educators have leadership skills [51], a minimal level of related confidence, some technical competency and communication skills.

In the context of health, [52, Green et al., 2020; de Vasconcelo Padrao et al, 2021], peer educators who: demonstrate an interest in the health condition [52; Padrao], have relevant extracurricular experience [52, Green], particularly involving leadership [Green; Padrao] and exhibit willingness to dedicate time to service were most successful [52, Green; Padrao]. Most recently, notions of practical knowledge and practical wisdom have been suggested to be key for youth leaders to be effective [Christensen et al., 22]. Peer self-assessments of competency also have been shown to be important [53]. Indeed, these findings are supported by evidence that self-reported competency including achievement motivation, self-efficacy and collaborative ability are not only important but also may be attributes associated with willingness [54].

We present data from a feasibility study of implementing a peer educator approach to increase G x E literacy among youth. We pose the following research questions: (1) What
attributes are associated with youths’ competency to disseminate G x E explanations of podoconiosis?; (2) What attributes are associated with youths’ willingness to disseminate G x E explanations of podoconiosis? and (3) Do these attributes moderate the association between competency and willingness?

**Materials and Methods**

**Study population**

Data come from a cross sectional survey conducted with 377 youth (41 were from families affected by podoconiosis to represent the 10% of families affected by the condition) living in communities in the Wolaita zone, where podoconiosis is endemic, of Southern Ethiopia. Data collection was conducted between August-September 2017. A detailed description of the survey and sampling methods is provided elsewhere [60].

Youth were eligible if they were ages 15-24 and resided in one of the two study communities (Tome Gerera and Sura Koyo). We conducted a census to identify households with eligible youth to create a sampling frame and draw a random sample. power analyses indicated that an optimal sample size to be 347 youth (95% confidence to detect ?? difference). Of the total 3542 youth enumerated, 5% could not be reached; 377 youth were approached to complete the survey that was administered by trained enumerators

**Survey development**

We used an iterative qualitative process to guide survey development. This process is described in detail elsewhere [Allen et al., 2017]. Briefly, we engaged a team of scientist experts and a group of lay individuals (youth in areas of endemic podoconiosis) to each produce a schematic mental model of the factors that believed caused podoconiosis. The expert’s mental model was used as the gold standard. We based misconceptions and gaps in knowledge on differences
between the youth and expert models. These “gaps” guided our survey items intended to quantify the prevalence of these differences in the target communities. Examples include degree of endorsement of: contagion, spiritual influences, inheritance, shoes as adequate prevention, and avoidance of personal contact. We also assessed whether the youth knew anyone personally affected by podoconiosis (yes/no), had knowledge of how gene and environment factors influenced podoconiosis development, and self-rated confidence to explain G x E contributors to podoconiosis. Lastly, the survey assessed factors described in the literature to influence competence. This included youth’s age, gender, formal education (yes, no), reported any civic activities, ever having participated in health-related civic activities (e.g., interactions with health extension work) (yes/no), or having any civic leadership role (yes/no).

Written informed consent was obtained from all participants. Thumbprints were taken from those who were not able to sign the information sheet and consent forms. For youth under the age of 18, consent was obtained from their parents or guardians.

**Dependent Measures**

**Willingness** was measured using four indicators with three scale response categories (1=not willing, 2=undecided, 3=willing e.g., *How willing would you be to volunteer to educate the community about the causes of podoconiosis?*). The Cronbach alpha for the willingness scale was 0.95. Responses to this item were highly skewed thus we coded willingness as a dichotomous variable where 0 represented not willing and 1 represented more willing using the median (11) as a cut point.

**Objective Competency** was a composite score drawn from the sum of three separate scales; Accuracy of G x E knowledge, number of misconceptions about influences on podoconiosis
endorsed (0-11), and confidence to explain these influences to peers (9-27). The G x E knowledge variable was measured by responses to four true/false questions (scored from 0-4 correct, e.g., “A person who has relatives with podoconiosis will certainly get the disease”. Misconception endorsement was assessed using 11 true/false responses (range 0-11 correct, e.g., Podoconiosis can be transmitted when people make physical contact with the blood or body fluids of a patient”. Confidence to explain was measured with 9 questions with responses assessed on a 3-point scale (agree-1 undecided-2 and disagree-3, e.g., “I am confident that I could explain to other people why some individuals develop podoconiosis and others do not”. A point was given for each agree response and 0 for disagree and undecided responses, with a range from 0-9. We derived a competency composite score by summing up the three scores (range 0 - 24); in analysis, we treated the competency score both as a continuous variable and as a variable dichotomized at the median point of 13 (0 for lower competency and 1 for higher competency).

Data analysis

Bivariate associations between predictor variables and dependent variables (willingness and competency) were assessed using the Statistical Software package (SAS) version 20. Binary logistic regression models were fit to examine associations with the main and interaction effects of covariates with the binary outcome of willingness (not willing and willing). Bivariate analysis was conducted to identify significant differences in competency by each attribute using an independent t-test for binary independent variables and analysis of variance (ANOVA) for three level categorical age.

Results

Description of sample participants
Of the 377 youth who participated (100% response rate), the mean age was 17.7 (SD= 2.3, range 15-24); 52% were female and 95% reported having some formal education. Over half of the respondents (58.6%) reported that they had participated in extracurricular/civic activities and 12% reported having played a leadership role in civic activities in their community. Forty-four participants (11.7%) reported that they had friends who were affected by podoconiosis. The majority (79.8%) said they had been visited by Health Extension workers in the prior 12-months period.

[Table 1]

**Question 1: Which attributes are associated with youths’ competency to disseminate GxEx explanations of podoconiosis?**

Competency level was associated with all characteristics except age (F =1.18, P= 0.28; Table 2). Males had significantly higher competency levels than females (mean difference: 1.89; 95% CI, 1.10, 2.68). Youth with no formal education had lower competency than those who had attended some formal schooling (mean difference: -3.54; 95% CI, -5.35, -1.72). Youth from affected families had lower competency than youth from unaffected families (mean difference: -1.68, 95% CI -2.99, -0.37). Youth who had no friendship attachment with affected individuals had lower competency than those who had friends affected by podoconiosis (-1.63, 95% CI -2.84, -0.38).

Youth who had not participated in civic engagement had significantly lower competency scores than those with civic engagement experience (mean difference: -1.85, 95% CI -2.65, -1.05). Youth who reported no community leadership roles had lower competency than those who had experience in leadership (-1.83; 95% CI -2.11, 0.99). Youth who had not been visited by the
HEWs over the prior 12 months period had lower competency than those who had contact with HEWs ( -2.49, 95% CI -3.47, -1.42).

Table 2

Question 2: Which attributes are associated with youth willingness to disseminate G x E explanations of podoconiosis?

Due to the skewness of the willingness score we used a non-parametric Wilcoxon rank-sum test (Mann-Whitney U) to examine associations between independent variables and willingness. Median willingness to participate in G x E literacy building was significantly associated (Table 3) with: age -- older youth were more willing than younger youth, gender -- male youth more willing than females, education -- youth with some formal education were more willing than those with no formal education, civic engagement -- youth with civic connections were more willing than those without civic engagement, and leadership experience -- youth with leadership experience were more willing than those with no such experience (p= 0.01, p= 0.01, p=0.005, p=0.04, and p= 0.02, respectively). We also found significant associations of median willingness with objective competency -- youth who were more competent were more willing than those who scored as less competent (p<.001).

Table 3

Question 3: Do attributes moderate associations between competency and willingness?

Variables showing statistically significant associations with competency and willingness were further analyzed using a binary logistic regression model (high vs low willingness) to determine whether any of the factors moderated the association of competency with high willingness. First, individual covariates (i.e. competency, gender education, leadership role, civic engagement and age category) were included in the model to see whether the individual main
effect of each predictor was significantly associated with willingness. The main effects of all variables were significantly associated with willingness (P<0.05, Table 4). Competency remained significantly associated with willingness after controlling for the other covariates.

[Table 4]

We added an interaction term to the model to test whether the association of competency with willingness varied by level of the other covariates. Our findings showed no interaction effect between competency and other variables in predicting high willingness (p>0.05). However, examining the interaction in a 2 x 2 table, one can see that the association of competency and willingness did vary by gender and reported civic engagement. Among those with low competency, the odds of being willing was 1.87 times higher for males compared to females. (OR 1.87; 95% CI, 1.02, 3.40). Among those with low competency, the odds of being willing was 2.3 times higher for those who had experience in civic engagement as compared to those who did not have experience in civic engagement (OR 2.30; 95% CI, 1.27 – 4.18).

Discussion

Findings of this study suggest various attributes that must be considered in identifying potential youth innovators/early adopters who would be willing to serve as peer health educators. The first question assessed factors influencing competency as an important attribute for peer education. Based on bivariate analyses, numerous demographic (e.g., gender, education) and civic experiences (leadership experiences, interactions with health extension workers) were positively associated with youths’ competence to be peer G x E literacy builders. These findings are remarkably consistent with youth peer educators using single dimensional competency measures in other health contexts (Shepherd et al., 2010). However, our findings that affected
youth had generally lower competency is not consistent with research showing that those living with HIV/AIDS had high competency in other similar settings [61]. Measurement differences make it difficult to compare findings. Prior studies have used a variety of indicators of competency (e.g., self-evaluated, single item). Our measure was multi-dimensional with strong internal consistency.

Results were very similar for willingness to be peer educators. Indeed, competency and willingness were significantly associated. A few characteristics specific to podoconiosis with respect to willingness are worth noting. We found that affected youth were less willing to serve as peer educators than unaffected youth. Our prior qualitative research has consistently shown that social stigma surrounding podoconiosis impedes affected individuals from social interaction and community participation [62, 63]. This finding is inconsistent with other studies showing that education led by peer volunteers with a specific condition is beneficial [64]. For instance, the role of people living with HIV in providing peer support has been widely accepted and encouraged in Thailand for many years [65].

On average males had higher competency and willingness to participate than females. Similar results have been found on gender differences associated with youths’ willingness to participate in an agriculture education program in Nigeria [56]. Such gender differences could be reflections of the extant patriarchal and male dominated culture in the study communities as it is the nature of many LMICs. Limited exposure of women and girls in civic roles compared to their male counterparts may diminish girls’ views that peer education is an appropriate role for them. These results suggest the importance of recruitment approaches that illustrate the important role girls can play in peer education and build their confidence to be successful in this
role. Additionally, gender-tailored peer training may be needed to coach girls whereas boys may benefit from training with different foci.

Youth with some formal education were more willing to participate in literacy building activities. This finding was consistent with past research about qualities of peer educators for HIV prevention in South Africa [66]. It also indicates the possible benefits of integrating peer leader training in school setting as alternative pathway to disseminate G x E information.

Consistent with other research [67], youth’s civic and leadership experience was associated with greater willingness to serve as peer G x E educators. Participation in civic engagements may give youth the opportunity to acquire confidence and skills that enhance their willingness to help disseminate G x E messages.

The strong positive association of competency and willingness is encouraging in that those most likely to express willingness are also likely to be reasonably competent. This is consistent with assertions that competency is antecedent to voluntary participation [68]. For instance, a recent study [69] on participation of medical students on COVID-19 in Saudi Arabia found positive moderate correlation between willingness to work as part of the healthcare workforce during the pandemic and self-perceived competence score. This finding also suggests that youth who are willing may also be competent, though this self-selected group will systematically exclude girls and those with fewer civic experiences. This tradeoff must be considered by intervention planners in limited resource settings where use of robust competency measures are not available.

A notable strength of the study was that 100% of youth in the assembled sampling frame agreed to and completed the survey. Survey items related to competency were developed based
on an iterative mental model exercise. This is also the first study to address these questions by
designing competency composite measure in the context of G x E literacy building. Given the
scant body of research on voluntary participation of the youth as lay health advisors to
disseminate G x E information in podoconiosis, the present study provides important insights
that attributes contributing to successful peer education programs are similar in the context of G
x E education.

Limitations also should be noted. The sample was drawn from only two districts and
results may not be generalizable to other settings. We do not have repeated measures of the
indicators that would be needed to access the reliability of the competency score. Youth were
not provided with a description of what would be expected of them in the role of youth educator.
Thus, their responses are based on their own conception of what the role would entail. Despite
the comprehensiveness of our survey, we did not assess youths’ perceptions of barriers to being
effective in disseminating GxE information on podoconiosis. Lastly, the data was collected in
2017 and misconceptions and understanding of G x E effects on podoconiosis could have shifted.

Implications for future research

This report describes an initial attempt to conceptualize a composite set of skills youth need to be
competent genomic literacy builders. While these results should be replicated, the identified
associations between objective competency and willingness related to education, gender and
civic engagement could inform recruitment and training for youth lay educators. An important
next step is to test associations of predisposing characteristics with the composite assessment in
different contexts where G x E influences are pronounced. Additionally, repeated assessment of the composite to assess its reliability will also be key.

Conclusion

Youth peer educator programs have an important role in disseminating improved G x E literacy among LMICs. Our study suggests that many youth are both willing and competent to be peer educators. However, thoughtful recruitment and training strategies will be needed to ensure that the broadest group of youth have the opportunity to serve, particularly girls and those without formal education.

Acknowledgements

We would like to thank the youth who participated in the study. Authors also acknowledge officials in the Wolayta Zone and Woreda administrations for the support rendered to the study team during data collection and dissemination of the study. We would also like to thank all individuals taken part in facilitating the study and providing insightful comments to enrich the study report. We are also grateful for Dr Deborah McFarland for facilitating the thesis write up process.

Conflict Of Interest: Authors have declared that no competing interests exist.

Author Contributions: CM conceived and designed the study. DA wrote the first paper draft with the input form CM and circulated to other co-authors KE, GT GD and RM for review. KE and DA developed draft interview instruments and participated in data collection. KE contributed in coding the data and RM helped DA in data analysis. All authors read and approved the final version of the paper.
**Ethical Approval:** Ethical approval was obtained from the Institutional Review Board of the College of Health Sciences, Addis Ababa University, approval number AAU-MF-03-008.

Data availability statement: All the relevant data are with in the paper. Supplementary data will be shared on request to the corresponding author.

**Funding:** This project was supported by National Institutes of Health (NIH-1U01HG007628-03). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
References


