

Challenging the association between health literacy and health: the role of conversion factors

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Abstract:

Objectives: Previous studies have found substantial correlations between health literacy and various health outcomes. However, the role of social and personal factors in those links remains understudied. Applying a moderation approach, we assume that these factors function as conversion factors on the associations between health literacy and health outcomes. Consequently, we test if associations between health literacy and health outcomes are stronger among young male adults who score high in conversion factors compared to those who score low.

Methods: Cross-sectional data from the Young Adult Survey Switzerland was used for the analyses (n = 9339, age = 18 to 25). Multiple logistic regression analyses were applied to estimate associations between health literacy and health. Moderator analyses with three conversion factors and five health outcomes were conducted.

Results: For each health outcome at least one conversion factor moderated the association between health literacy and health according to the hypothesis. Although strength and form of the moderation effect differ across analyses, generally stronger associations were found among groups with beneficial social or personal factors.

Conclusions: The present findings support the hypothesis that conversion factors play a crucial role in the associations between health literacy and health. The findings, thus, point towards a potential risk of linear health literacy approaches that assume equal benefits from increased health literacy. Individuals with beneficial social and personal factors (those already privileged) may enjoy greater health benefits from interventions improving health literacy.

Introduction

Health literacy has been associated with different health outcomes including self-rated health (Howard *et al.*, 2006; Bennett *et al.*, 2009; Berkman *et al.*, 2011; van der Heide *et al.*, 2013; HLS-EU Consortium, 2012), physical health (Howard *et al.*, 2006), mental health (Howard *et al.*, 2006), utilization of preventive health care services (Bennett *et al.*, 2009; Berkman *et al.*, 2011), and hospitalization rates (Berkman *et al.*, 2011; HLS-EU Consortium, 2012). These results led scholars to lift health literacy into the illustrious circle of “determinants of health” (Rowlands *et al.*, 2017; van der Heide, 2016). Some studies appraised health literacy as a *key* determinant of health (Ellermann, 2017; WHO Euro, 2013; Kickbusch, 2001).

Against this background, many experts today consider health literacy as a key topic to tackle unequal chances for good health, including to reduce social inequalities in health. Especially vulnerable and migrant populations should be addressed by interventions that increase their health literacy (van der Heide *et al.*, 2013; Ellermann, 2017; WHO Euro, 2013). Further, health literacy has been suggested to empower those with poor health knowledge and poor health behaviours. It may help to manoeuvre more confidently through the health care system, to gain more autonomy in health decision making, and to make healthier choices in daily life (Batterham *et al.*, 2016; Nutbeam, 1998; Sørensen *et al.*, 2012; Lenartz *et al.*, 2016).

However, some scholars questioned the enthusiasm concerning the potentials of health literacy to empower those in need, the vulnerable and disadvantaged individuals or groups (Bittlingmayer and Sahrai, 2019; Abel and Frohlich, 2012). Particularly, evidence for intervention effectiveness among population subgroups is scarce (Pignone *et al.*, 2005; Berkman *et al.*, 2011; Barry *et al.*, 2013; Poureslami *et al.*, 2016). Barry *et al.* (2013) concluded in a meta-analysis, that “none of the studies were sufficiently powered to detect subgroup differences, and this area was highlighted as needing further research”. A potentially low effectiveness among groups with low social status may cause an ethical dilemma for health promotion activities. For example, Paakkari and George (2018) raised the question if health literacy skills taught in schools could reduce health inequalities. In other words, it is not yet clear if and under what conditions can health literacy interventions mitigate the effects of cognitive gaps between various groups or the effects of deprived living contexts, where individuals “may have only one option, because of limited spending power or other constraints” (Paakkari and George, 2018).

In the present study, we investigate the question if the associations between health literacy and health varies among groups of different personal and social contexts. We hypothesise that unequal life contexts can explain variations in the associations between health literacy and health. This hypothesis is derived from the capability approach and the concept of conversion factors as described below.

The role of conversion factors

Theoretical support for unequal benefits from health literacy interventions can be derived from the capability approach. Amartya Sen's capability approach is relevant here in particular for its concept of "conversion factors". The notion of conversion factors stresses the idea that it is not sufficient to know a person's resources and commodities in order to assess the well-being or health status he or she can potentially achieve (Robeyns, 2016). Rather, "we need to know much more about the person and the circumstances in which he or she is living" (Robeyns, 2016). An illustrating example is smoking behavior. Knowledge or financial resources may not be sufficient resources for an individual to quit smoking. Working environment factors, availability of cigarettes, motivation, mental stability and more need to be considered to estimate a smoker's chances to quit smoking or – in the words of Robeyns (2011) – to assess his or her "real freedom or opportunities".

Conversion factors play a major role in the process of decision-making and achieving individual goals. In the capability approach, they influence "*the extent to which* a person can transform resources" into an active agency and valuable functioning like bodily health (Hvinden and Halvorsen, 2018). Active agency refers to an active and often interactive process of a person trying to achieve a particular aim or outcome. It involves self-reflection, the evaluation of own experiences and the environment and takes the form of a well-informed planning and decision-making process. This process of evaluation and decision-making may be constrained or facilitated by personal, social, and environmental conversion factors (Hvinden and Halvorsen, 2018). Personal conversion factors are internal to a person and include physical and mental condition as well as reading skills and intelligence. Social conversion factors refer to societal factors such as social norms or public policies, and include also power relations related to class, gender, or race. Environmental conversion factors encompass the physical environment (Robeyns, 2016; Hvinden and Halvorsen, 2018).

Empirical appropriation of the theoretical concept of conversion factors is still under discussion (López Barreda *et al.*, 2019; Hvinden and Halvorsen, 2018). Conversion factors can be understood as multipliers or "conversion rates" that "capture the efficiency of the link from resources to achievements" (Chiappero-Martinetti *et al.*, 2019). For example, a study by Chiappero-Martinetti *et al.* (2019) revealed groups with different abilities to convert public, private, and nonfinancial resources into health. Hence, conversion factors operate as common moderators that influence the effect of a common explanatory variable X (inputs) on an outcome variable Y (achievements) (Chiappero-Martinetti *et al.*, 2019; Singh-Manoux, 2005). Hence, the decision about which factors are to be employed as conversion factors (or as resources) depends on the theoretical assumptions and particular research question.

To sum up, the theoretical contribution of the capability approach to the current health literacy study is not only to expand the range of relevant factors, but also to draw attention to and explain interactions between them. Discussing health inequalities from a health promotion perspective, Abel and Frohlich (2012) explain interactions of material and non-ma-

terial factors as “major parts of the dynamic processes in the (re-)production of health advantages and disadvantages” (Abel and Frohlich, 2012). Conversion factors, hence, are likely to multiply or constrain one’s opportunities for a healthy life and hold the potential to inhibit his or her “abilities or other internal powers” (Robeyns, 2016). Similarly, they multiply or amplify the effect of health literacy on health outcomes.

Health literacy and conversion factors

We suggest that health literacy should be understood as an individual resource that potentially interacts with conversion factors. We consider health literacy as a principally modifiable and achievable set of personal resources needed to take healthy decisions (Rademakers and Heijmans, 2018). At the same time, there are rather stable and less modifiable structural, contextual conditions, and personal capacities that are essential to act upon these decisions (Rademakers and Heijmans, 2018). These later factors may operate as conversion factors, constrain or enable the process of active agency and the transformation of healthy decisions into good health outcomes. Consequently, we focus here on health literacy as a set of personal knowledge and skills needed to deal with health matters in the private realm (Abel *et al.*, 2014). This focused definition allows distinguishing health knowledge and health skills from more stable and less modifiable structural, contextual, and personal factors. Whereas knowledge and skills can be enhanced by health professionals or health promotion activities, the personal, social, and environmental factors mentioned in the previous section may be more stable and harder to change through educational interventions.

The role of moderating factors has been identified in a health literacy model established by Edwards *et al.* (2012). Elaborated on the grounds of patient interviews, the model describes five consecutive stages from (1) health knowledge, (2) health literacy skills and practices, (3) health literacy actions, (4) production of informed options to (5) the realization of an informed health decision. The model addresses what we introduced above as conversion factors. It describes multiple personal, social, and professional facilitators and barriers, which foster or impede their patients to proceed from one to the next health literacy stage (Edwards *et al.*, 2012). For example, fears and anxieties associated with diabetes deterred a patient from accessing support from a GP (step three). Friends and family have been mentioned as facilitators to build up a better understanding during stressful consultations with lots of complex information (step four).

Recent studies support the consecutive character of the model. For example, high levels of particularly functional and communicative health literacy are preconditions for shared decision making used in stages tree to five (Ousseine *et al.*, 2019). Another study emphasizes the role of disability and impairments like perception disorders, brain damage, traumatic learning disorders or other disorders that impede one’s possibility to achieve higher levels of health literacy (Bittlingmayer and Sahrai, 2019). Hence and although developed in a clinical context, the model by Edwards *et al.* (2012) addresses – without explicitly mentioning – the

important role of conversion factors. Furthermore, it can help to interpret the mixed findings mentioned above from previous health literacy studies.

To sum up, addressing moderation effects in health literacy research is an attempt to overcome the restrictions of linear models presented in the literature – e.g. the models of Rüegg and Abel (2019), Sørensen *et al.* (2015), Nutbeam (2008), Manganello (2008), or Paasche-Orlow and Wolf (2007) – and to advance our understanding of differentiated health literacy effects (Pelikan *et al.*, 2018).

Study hypotheses

To our knowledge, no study investigated in the effect of conversion factors or interaction effects regarding the association between health literacy and health outcomes. Addressing this research gap, this study investigates if and to what degree conversion factors play a role on the pathway from general health literacy to health outcomes. To this end, we simplify the five-stage model from Edwards *et al.* (2012) using health literacy as “knowledge and skills to prevent disease and to promote health in everyday life” (Abel *et al.*, 2014) on one side and different health outcomes on the other (figure 1). We assume different conversion factors that influence someone’s chances to successfully transform health literacy into a good health outcome. This effect is theoretically explained through a higher or lower agency (not included in the empirical model).

[Insert figure 1. Conceptual health literacy model... – here]

Notes: This conceptual graph describes a simplistic model how conversion factors are tested in the analyses. Strong assumptions underly this model if the empirical results want to be interpreted as causal. In this study, we are not interested in causality, but rather in the existence of differences in the association between health literacy and health. Differences are supposed to occur due to the moderating effect of conversion factors. According to the capability approach, conversion factors constrain or facilitate the transformation of a resource like health literacy into active agency and, thus, into an achieved functioning like health.

Two personal and one social conversion factor (lower secondary educational degree, mental health, and parental social status) were applied to test the moderating effects. Using a large and socially diverse cross-sectional data set, we hypothesize that young adults who score higher on the conversion factors having stronger associations between health literacy and health outcomes than their colleagues with lower scores. In other words, we expect young adults in better personal or social conditions to have more opportunities to transform health literacy into better health outcomes compared with their colleagues in poorer personal or social conditions. For the first group we expect higher associations between health literacy and health outcomes than in the second group (hypothesis 1). Since we apply three different conversion factors and five distinct health outcomes, we do not expect to find equal results across all analyses. Rather, the moderating effects may vary due to complexity (Keshavarz Mohammadi, 2019) and depend on the conversion factor and the health outcome (hypotheses 2).

Further, we used mental health in two different ways. On the one hand, we defined mental health as a dimension of health and to that end as a desirable functioning or outcome in the sense of the capability approach (Hvinden and Halvorsen, 2018). On the other hand, we will explore the role of poor mental health as a form of disability and, hence, also as a personal conversion factor (Robeyns, 2016).

Methods

Data

We used data from the second wave of the Young Adult Survey Switzerland (YASS) which was conducted in 2015/2016 in Switzerland. The all-male sample was collected during recruitment for compulsory military service with a participation rate of 90%. This sample corresponds to 14% of the eligible male population of Switzerland aged between 18 and 25. One-third of the participants received an additional health questionnaire with health literacy and health items used in the analyses. The survey design is described in more detail elsewhere (Hofmann *et al.*, 2013). The net sample consisted of 9'339 cases after excluding cases with missing data in health literacy score or in one of the two control variables, age and language region (19%).

Measures

We used self-rated health, overweight, smoking behavior, mental health, and suicide ideation as health indicators. Due to non-normal distributions, all health indicators were transformed into dichotomous variables where “1” represents good health or favorable health behavior, respectively.

Since we observed an overall high health level, *self-rated health* was categorized into 1 = “excellent” and “very good,” and 0 = “good,” “less good,” and “poor”. Overweight was dichotomized into 1 = “no overweight, body mass index < 25” and 0 = “overweight, body mass index \geq 25”. *Smoking behavior* was transformed into 1 = non-smokers and 0 = “every now and then” or “daily” smokers. To measure *mental health*, we used the validated 9-item depression diagnostic and severity measure, PHQ-9, from Kroenke and Spitzer (2002). Following the authors recommendations, we transformed the index measure into 1 = “none” and 0 = “mild” and “severe” depression tendency and used these categories for good or poor mental health. Suicide ideation was measured with the question: “Do you have thoughts of rather being dead or harming yourself?” The answers were categorized into 1 = “not at all” and 0 = “some days/more than half of the days/nearly every day”.

To assess health literacy levels, we applied the validated “short survey tool for young adults and public health research” (Abel *et al.*, 2014). This instrument includes eight Likert-scaled items with four questions on functional health literacy and two questions each on interactive and critical health literacy. Observations with one or two missing values have been mean imputed and included in the analyses. Observations with more missing values have

been excluded. The health literacy score ranges from 0 to 30. The instrument applies to our focused definition health literacy as introduced above.

We applied three conversion factors in our analyses: a young adult's own lower secondary degree (LSD), the parent's socioeconomic status (PSES), and the own mental health (MH). In Switzerland, compulsory school ends at the age of 16 with one of three different secondary degrees "Realschule", "Sekundarschule" and "Gymnasium", which we renamed with low, intermediate, and high level. Hence, we included *LSD* using these categories. *PSES* was assessed by a factor analysis with four indicators: household equivalent income, parental financial situation, highest parental educational achievement, and the number of books at home. We used sextiles to split the participants in six subgroups. Each sextile contained approximately 1'200 cases which appeared to be a good balance between statistical power and discrimination of different effect sizes. Last, we used the same depression tendency score described above as third conversion factor (MH).

Analyses

To identify moderation variables and their effects, two basic procedures can be applied: Moderated regression analysis commonly realized by interaction terms or by multi-group analysis or subgroup analysis respectively. Both procedures provide insights into different functions of a mediator variable (Helm and Mark, 2012). Although both approaches are statistically feasible, they have both several deficits. Moderated regression analysis is typically used for model testing or increasing predictive ability. On the other hand, this approach is susceptible to biases due to multicollinearity, statistical power, artificial dichotomization, and interpretation difficulties (Keller, 2019; Memon *et al.*, 2019; Wang and Ware, 2013). Although it has been described as an efficient method in intervention studies, it can lead to either false-positive or false-negative results (Keller, 2019; Widaman *et al.*, 2013).

On the other hand, multi-group analysis appears to be a more straight-forward approach that is especially reliable for the analysis of associations (compared to the modelling of causal effects). Particularly, it has been recommended to identify a specific type of moderators named *homologizer* variables. (Sharma Subahsh *et al.*, 1981; Cerin, 2014). By definition, this type of moderator influences the strength of a relationship but not its variables (Allison *et al.*, 1992; Sharma Subahsh *et al.*, 1981). Since this study investigates in the comparison of associations, multi-group approach appears to be more reliable than the moderated regression approach.

We used STATA 15.1 for the analyses. Association analyses were conducted for multiple subgroups, stratifying the sample by different levels of conversion factors (CF). Because differences in standard deviations influence the coefficients and significance levels, standard deviations were analysed for potential variances between subgroups. To avoid the analysis of approximately the same groups using different moderation variables, subgroup stratifications needed to be tested for overlaps. Cross-tabulations were used to detect identically stratified

subgroups. The analyses were conducted with multiple logistic regression controlling for age and language region.

Results

Descriptive results

The descriptive results of the net sample are displayed in table 1. All three conversion factors have remarkable associations with health literacy and health outcomes. The higher a young male adult scores on the conversion factors, the higher his health literacy score and his chance of achieving a better health outcome.

Missing rates are also listed in table 1. The missing cases of each conversion factor are displayed in the second column, 395 (1.1%) for LSD, 2159 (23.1%) for PSES, and 198 (2.1%) for MH. Since these three groups with missing data have similar health distributions and missing rates as the total sample, we do not expect bias excluding them from the analyses. Further, relatively high missing rates have been found in the smoking variable. Again, smoking missing rates are roughly equally distributed among each conversion factor's subgroups. Hence, we did not expect bias using only the valid cases for the analyses.

[Insert table 1. Study population – here]

Note: Data from Young Adult Survey Switzerland, Switzerland 2015/16

[Insert table 2. Distributions between conversion factors – here]

Note: Data from Young Adult Survey Switzerland, Switzerland 2015/16

In table 2 the distributions of cases between the three conversion factors are displayed. First, we observe strong linear associations between LSD and PSES. Young adults with a higher socioeconomic parenthood are more likely to have a higher level of secondary degree. Secondly, we observe a curvy-linear association between mental health and LSD and PSES respectively. It is more likely to obtain a good MH with a middle-range or a high score than with a low score in LSD and PSES. In this respect, the three conversion factors indeed correlate, but are distinct phenomena that deserve to be treated separately. Furthermore, we observe roughly equally distributed missing rates among all three conversion factors.

Moderation analyses

Table 3 shows the odds ratios of health literacy for five different health outcomes calculated separately for each group and each health outcome. Each coefficient and confidence interval represent the result of one single logistic regression using the whole sample (first row) or the structurally stratified subgroup samples (second to twelfth row) controlling for age and language region. Each different pair of conversion factors and health outcomes represents one of 14 moderation analyses.

[Insert table 3. Associations between health literacy... – here]

Notes: Data from Young Adult Survey Switzerland, Switzerland 2015/16; OR = odds ratio; control variables: age, French speaking, Roman speaking; *** $p < 0.001$; ** $p < 0.01$; bold = coefficients higher than average.

^a Parental socio-economic status has been measured by four factors: highest parental achievement of mother and father, household equivalent income, subjective financial situation, and number of books at home.

To obtain a quick overview of the coefficients in the moderation analyses, we have highlighted all associations that are higher than the average of the whole sample (bold). Focussing on these coefficients, we see that the highest associations between health literacy and health outcomes are generally among those groups of young male adults that score middle or high on the conversion factors.

Regarding each health outcome separately, we observe at least one conversion factor moderating its association with health literacy. Among *self-rated health*, *mental health*, and *suicide ideation* the moderating effects are predominantly linear or curvy-linear. Young adults from middle-range or high CF groups have generally higher associations between health literacy and health than their colleagues from low CF groups. One exception among these outcomes is LSD on health literacy's association with suicide ideation. Here, no obvious moderating effect can be observed. The association between health literacy and *overweight* is only moderated by PSES. The association between health literacy and *smoking* is linearly moderated by MH, unspecifically moderated by PSES, and is reverse linearly moderated by LSD.

In general, the highest associations between health literacy and health outcomes were observed amongst those young male adults with middle or high scores in conversion factors. Moreover, in each of the five associations analysed we found significant conversion factor effects (at least one) that moderated the association. In only one out of 14 moderation analyses we found the highest association among the group with the least beneficial factors (LSD on health literacy/non-smoking). Here, low levels of statistical significance call for caution and more scientific investigations. In 10 out of 14 moderation analyses we found expected moderation effects. Thus, most of the moderating effects indicate curve-linear relationships, suggesting to re-consider basic assumptions about linearity in the associations between health literacy and health outcomes.

Overall, our data provide strong support for our main hypothesis suggesting higher associations between health literacy and different health outcomes among young adults that score higher in conversion factors. At the same time, moderating effects are shown to be complex and depending on the chosen health outcome and conversion factors. Hence, our data supports also our second hypothesis.

Discussion

Health literacy has been found to be associated with many different health outcomes in the area of self-rated health, physical and mental health, hospitalization rates, physical activity, oral health, and even alertness and health complaints (Howard *et al.*, 2006; Berkman *et al.*,

2011; Paakkari *et al.*, 2019). Hence, many scholars have claimed health literacy to be a means to tackle health inequalities. Since it is not easy to change upstream social determinants of health within a reasonable time span, health literacy has been considered as a mediating and modifiable factor that may generate quick effects in public health (Stormacq *et al.*, 2018). It has been argued that especially the most vulnerable and migrant people should be equipped with higher health literacy to achieve better health behavior and better health outcomes (Sørensen *et al.*, 2012; WHO Euro, 2013; Ellermann, 2017).

In this study, we investigated in the question if health literacy may be a toolkit to address poor health of those with less favorable personal and social attributes. Referring to Amartya Sen's capability approach and the concept of conversion factors, we studied the moderating effect of young adults' lower secondary degree (LSD), parental socioeconomic status (PSES), and mental health (ML) on the association between health literacy and health. We hypothesized that the associations between health literacy and health are stronger among young male adults with higher LSD, higher PSES and better ML and weaker among their colleagues with lower LSD, PSES or poor ML.

The results support the first hypothesis in general. Moderating effects were found in the associations between health literacy and for all five health outcomes. At least one conversion factor moderated the associations according to the hypothesis. In only one out of 14 moderation analyses we observed the highest association among the group with the least beneficial factors. Secondly, our analyses support the second hypothesis that strength and form of the moderation effect differ across conversion factors and health outcomes.

Our work should be understood as an exploratory study investigating the complex mechanisms between health literacy and health. Using a large dataset from young adults and insights from the capability approach as theoretical guidance, our analyses show that not all population subgroups may be able to transform health literacy into better health outcomes. Barriers such as low educational degree, parents from low socioeconomic classes, or poor mental health are likely to impede the transformation of health literacy into an active agency and, further, into a positive health outcome. On the other side, young male adults with more facilitators and less barriers seem to provide better chances to transform health literacy into good health outcomes.

Our findings speak against an uncritical interpretation of health literacy as a basic determinant of health. The data shows, that a narrow focus on personal health knowledge and skills may neglect or downplay the unequal chances *to act* upon this knowledge and skills. A more critical approach can help to explain why health literacy is not associated with a healthy behavior among large groups in our sample. Health literacy was not a determinant for selected health behaviors among these groups and we argue that this is because of the key role of conversion factors. Alike Nutbeam and Lloyd (2021), we thus suggest to understand health literacy as necessary but, not sufficient precondition for individuals (or communities) to achieve favorable health outcomes.

Our findings call for future health literacy studies that give more and specific attention to those people with the least powerful personal and social factors to transform health literacy into real health benefits. Study samples should be designed to go deeper into the effects of personal, social, and environmental conversion factors. Observational studies should question linearity assumptions when analyzing the effect of health literacy on health outcomes and should give attention to complex, nonlinear interaction effects (Pearl and Mackenzie, 2018). Lastly, health literacy intervention studies should provide answers to the question if they are able to reduce existing health inequalities (Stormacq *et al.*, 2020).

Limitations and strengths

The current analyses were restricted to an all-male sample. When it comes to health and health behaviours young male adults are a particularly interesting subpopulation (e.g., regarding their health risk behaviours). Still, the findings are limited with respect to possible gender differences, calling for similar studies in female populations. The participants in this study have a rather narrow age range from 18 to 25 years. Again, this calls for caution when generalizing the results to other age groups.

There are noticeable strengths of this study. The data collection during the military recruitment procedure ensures a sufficient number of respondents of all social strata. Hence, the study sample has sufficient statistical power to detect differences between the study subgroups including those that score low in conversion factors. Moreover, the separated analyses for each subgroup allowed to identify non-linear moderation effects and, hence, to escape the risks of “linear wonderland” (Pearl and Mackenzie, 2018).

Conclusions

We found stronger associations between health literacy and health among those young male adults who score high in conversion factors compared to those who score low. This study supports the hypothesis that conversion factors play a crucial role in the complex associations between health literacy and health. The present findings await confirmation in future studies using data from a wide range of subpopulations.

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