Introduction

Health literacy is the combination of personal competencies and situational resources needed for people to access, understand, appraise and use information and services to make decisions about health. It also includes the capacity to communicate, assert and act upon these decisions. The concept of health literacy thus imply a broad spectrum of dynamic individual skills but is operationalized through the individual’s interaction with healthcare systems and services. The demands and complexity placed upon the individual by these systems are therefore critical to the health impact of health literacy individual challenges. The Shanghai Declaration on promoting health in the 2030 Agenda for Sustainable Development endorsed by World Health Organization (WHO) in 2016 recognizes health literacy as a critical determinant of health and a vital component of effective responses towards inequality in health. Health literacy has been on the international research agenda for more than two decades. The prevalence of low health literacy has for Sustainable Development' endorsed by World Health Organization (WHO) in 2016 recognizes health literacy as a critical determinant of health and a vital component of effective responses towards inequality in health. Health literacy has been on the international research agenda for more than two decades. The prevalence of low health literacy has been found to be as high as one in four depending on context and measurement instrument. Low health literacy has been associated

Large diversity in Danish health literacy profiles: perspectives for care of long-term illness and multimorbidity

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Background: Health literacy is an important, modifiable, social determinant of health. This study aims to explore health literacy challenges of people with long-term illness or multimorbidity and provide detailed profiles revealing health literacy strengths and weaknesses within a Danish population. Methods: In this cross-sectional study among Danish individuals (n = 490), health literacy was assessed using the nine-scale Health Literacy Questionnaire (HLQ). Using multiple logistic regression and hierarchical cluster analysis, we estimated the association between HLQ scale scores and the likelihood of long-term illness and multimorbidity, and identified sociodemographic and health characteristics related to profiles of health literacy strengths and weaknesses. Results: An increase in ‘actively managing my health’ and ‘social support for health’ decreased the odds of having a long-term illness [odds ratio, OR 0.53 (0.31–0.9); OR 0.43 (0.24–0.74)] and multimorbidity [OR 0.51 (0.26–0.98); OR 0.33 (0.17–0.62)], respectively. Conversely, an increase in ‘healthcare provider support’ increased the odds of having long-term illness [OR 2.97 (1.78–5.08)] and multimorbidity [OR 2.94 (1.53–5.87)], respectively. Five profiles were identified based on the cluster analysis. Each cluster was characterized by specific health characteristics, e.g. Cluster A by better health status (χ² = 39.976 (4), P < 0.001) and well-being (χ² = 28.832 (4), P < 0.001) and Cluster D by poor health status (χ² = 39.976 (4), P < 0.001) and increased likelihood of long-term illness (χ² = 18.641 (4), P < 0.001). Conclusions: The association of health literacy with long-term illness and multimorbidity in combination with the health literacy profiling based on cluster analysis provides a comprehensive needs assessment and a promising starting point for the development of health literacy responsive interventions.
with social determinants of health such as financial deprivation, low educational level, living alone and non-indigenous ethnicity\textsuperscript{4–6} as well as health indicators such as self-assessed health, health behaviour and prevalence and effect of long-term illness and multimorbidity\textsuperscript{5–9}.

Health literacy is an unequally distributed but modifiable determinant of prevention and treatment of major non-communicable diseases including cardiovascular conditions\textsuperscript{10} and diabetes\textsuperscript{11} making it an inevitable target of health inequality interventions.\textsuperscript{12,13}

Effective development of such interventions is dependent on detailed knowledge and qualification of the specific health literacy challenges within a target population when compared with other populations.\textsuperscript{13–17} The Australian Health Literacy Questionnaire (HLQ) was designed to capture both intrinsic and extrinsic dimensions of health literacy—that is, the ability of an individual to understand, engage with, and use health information and health services and the perceived ability of organizations to promote such activity. The questionnaire provides a comprehensive profile of a population’s health literacy strengths and challenges allowing in depth analysis and tailored intervention development.\textsuperscript{18–20}

This study aims to explore health literacy challenges of people with long-term illness or multimorbidity and provide detailed profiles of health literacy strengths and weaknesses within a general Danish population usable for comparison with other Danish or non-Danish populations.

**Methods**

**Data collection**

Data collection for this cross-sectional study was undertaken as part of the Danish adaption and validation of the HLQ and is described in detail elsewhere.\textsuperscript{21} The HLQ normally takes at least 20 min to administer face-to-face, but the interviews were longer (>30 min) since they also included socio-economic measures. In brief, health professionals and students collected data in face-to-face interviews using a standardized protocol. Data collection took place in a variety of settings including community health centres, general practices, work places and public fora by means of convenience sampling. As all Danes are affiliated to a primary care physician free of charge, and can be referred to e.g. rehabilitation, people in primary care waiting rooms represent a broad population. However, no data were collected regarding refusal rate or characteristics of non-participants.

**Measures**

**Health literacy**

Health literacy was measured using a Danish version of the original Australian HLQ. The HLQ was designed using a grounded, validity-driven approach and has shown strong construct validity, reliability and acceptability.\textsuperscript{18,22} The translation was validated using forward–backward translation, consensus conference and cognitive interviews.\textsuperscript{21} The questionnaire contains 44 questions covering the following nine distinct aspects of health literacy each represented by a scale:

1. Feeling understood and supported by healthcare providers;
2. Having sufficient information to manage my health;
3. Actively managing my health;
4. Social support for health;
5. Appraisal of health information;
6. Ability to actively engage with healthcare providers;
7. Navigating the healthcare system;
8. Ability to find good health information;
9. Understand health information well enough to know what to do.

Response options in scales 1–5 are on a four-point ordinal scale and include ‘strongly disagree’ (1), ‘disagree’ (2), ‘agree’ (3) and ‘strongly agree’ (4), while response options in scales 6–9 are on a five-point ordinal scale and include ‘cannot do’ (1), ‘very difficult’ (2), ‘quite difficult’ (3), ‘quite easy’ (4) and ‘very easy’ (5). For each scale, mean [standard deviation (SD)] score across the 4–6 included questions is calculated to represent the scale score (range 1–4 in scales 1 through 5 and 1–5 in scales 6 through 9).

**Socio-demographic measures**

As part of each interview, data on the participant’s age, gender, educational level, cohabitation and mother tongue were collected. Educational level was categorized as ‘still in school’, ‘7 or fewer years of school’, ‘8–9 years of school’, ‘10–11 years of school’, ‘high school diploma’ and ‘other’. For analyses, any level below ‘10–11 years of school’ was considered ‘low education’. Cohabitation was dichotomized as ‘lives alone’ or ‘living with someone’ the latter being either spouse/common-law partner, parents, children below 16 years, youths 16–20 years, or other adults. Mother tongue was defined as the primary language spoken/learned during childhood and was dichotomized into the categories ‘Danish’ and ‘Non-Danish’.

**Health measures**

Participants were asked to evaluate their general health status according to the general health domain (GH) of the SF Health Surveys.\textsuperscript{23} Answers were categorized accordingly as ‘excellent’, ‘very good’, ‘good’, ‘less good’ and ‘poor’. For analyses, the categories ‘less good’ and ‘poor’ were considered low health status.

Likewise, participants reported general well-being (‘How would you characterize your general well-being and quality of life?’) as ‘really good’, ‘good’, ‘fair’, ‘poor’ and ‘very poor’, and in the analyses we considered ‘poor’ and ‘very poor’ as poor well-being.

The presence of any long-term illness or disability (more than 6 month’s duration) as well as presence of a range of specific diseases were reported (17 disease categories). Prior to analyses, these data were used to define two health challenged subgroups comprising people reporting at least one long-term illness lasting >6 months (termed ‘long-term illness’), and people reporting three or more current illnesses (termed ‘multimorbidity’). Both subgroups are of high interest from a societal and health system perspective due to their relatively higher health care consumption and worse health outcomes compared with healthy individuals.

**Statistical analysis**

Hierarchical cluster analysis was conducted based on all nine HLQ scale scores using Square Euclidian Distance as the distance measure and Ward’s linkage as the clustering method.\textsuperscript{24} This explanatory technique allows was used to describe patterns of health literacy in the population. The optimal number of clusters was determined by considering the variance of HLQ patterns and dismissing cluster solutions with very small cluster sizes as described by Batterham et al.\textsuperscript{19} The method has been chosen because it is included in the well-validated Ophelia intervention development approach currently being tested in multiple European settings, including an ongoing health literacy initiative in Denmark.\textsuperscript{19,25}

Since the HLQ scales use two different response ranges (1–4 and 1–5), all scores were converted to z-scores prior to clustering. Unadjusted and adjusted multiple logistic regression methods were used to estimate the association between the health literacy scales and outcome variables. Adjusted regressions included age, gender, cohabitation, Danish mother tongue and education. All regression analysis results were presented with 95% confidence interval. Significance level was set at $P < 0.05$. All statistical procedures were conducted using the R language and environment for statistical computing.
Table 1 Participant characteristics in total population, clusters and subpopulations

| Socio-demographic factors                   | All (N = 490) | Cluster A (N = 91) | Cluster B (N = 34) | Cluster C (N = 193) | Cluster D (N = 131) | Cluster E (N = 22) | Long-term illness (N = 199) | Multi-morbidity (N = 91) |
|---------------------------------------------|---------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------------|--------------------------|
| Age, mean (SD)                              | 50.50 (17.34) | 51.00 (16.63)      | 49.26 (15.90)      | 50.47 (17.99)      | 51.13 (16.78)      | 51.77 (17.93)      | 57.39 (15.12)              | 60.00 (12.98)              |
| Old age (≥60 years), N (%)                  | 151 (31)      | 16 (18)            | 8 (24)             | 22 (11)            | 27 (21)            | 11 (50)            | 22 (26)                   | 47 (50)                  |
| Female gender, N (%)                        | 293 (60)      | 36 (40)            | 17 (50)            | 36 (19)            | 33 (25)            | 28 (126)           | 28 (26)                   | 50 (55)                  |
| Living alone, N (%)                         | 93 (19)       | 11 (12)            | 5 (15)             | 11 (6)             | 16 (12)            | 9 (41)             | 16 (50)                   | 7 (8)                    |
| Non-Danish mother tongue, N (%)             | 36 (7)        | 7 (8)              | 5 (15)             | 11 (6)             | 11 (8)             | 11 (50)            | 16 (25)                   | 5 (5)                    |
| Low education, N (%)                        | 95 (19)       | 12 (13)            | 5 (15)             | 11 (6)             | 10 (8)             | 10 (45)            | 16 (25)                   | 5 (5)                    |

Health related factors

| Low health status (Score 4 or 5), N (%)     | 222 (45)      | 32 (35)            | 12 (35)            | 37 (19)            | 29 (22)            | 21 (95)            | 143 (72)                  | 78 (86)                  |
| Poor well-being (Score 4 or 5), N (%)      | 95 (19)       | 8 (8)              | 4 (12)             | 11 (6)             | 11 (8)             | 11 (50)            | 78 (86)                   | 50 (55)                  |
| Long-term illness, N (%)                   | 199 (41)      | 38 (42)            | 8 (24)             | 24 (12)            | 24 (22)            | 24 (12)            | 199 (100)                 | 76 (84)                  |
| Multimorbidity (3 or more), N (%)          | 91 (19)       | 14 (15)            | 4 (12)             | 31 (17)            | 27 (23)            | 27 (13)            | 131 (66)                  | 76 (84)                  |

Table 2 Associations between HLQ scales and the likelihood of long-term illness and multimorbidity

| Long-term illness [n = 199 (41%)]          | Multimorbidity [n = 91 (19%)] |
|-------------------------------------------|-------------------------------|
| Unadjusted OR 95% CI                       | Adjusted OR 95% CI            | Unadjusted OR 95% CI                       | Adjusted OR 95% CI                       |
| 1. Healthcare provider support             | 1.29 0.95–1.76 2.97*          | 1.78–5.08                                   | 1.21 0.82–1.79 2.94*                     | 1.53–5.87                     |
| 2. Having sufficient health information    | 0.51* 0.36–0.72 0.57          | 0.32–1.02                                   | 0.55* 0.36–0.84 0.59                     | 0.29–1.19                     |
| 3. Actively managing my health             | 0.60* 0.43–0.84 0.53*         | 0.31–0.90                                   | 0.61* 0.40–0.93 0.51*                    | 0.26–0.98                     |
| 4. Support for health                      | 0.46* 0.31–0.66 0.43*        | 0.24–0.74                                   | 0.39* 0.25–0.61 0.33*                    | 0.17–0.62                     |
| 5. Appraisal of health information        | 0.65* 0.46–0.90 1.11         | 0.65–1.89                                   | 0.70 0.46–1.06 1.52                      | 0.78–3.01                     |
| 6. Ability to actively engage with         | 0.97 0.71–1.33 0.9            | 0.51–1.59                                   | 1.06 0.72–1.59 1.42                      | 0.71–2.88                     |
| healthcare providers                      |                               |                                           |                                           |                              |
| 7. Navigating the healthcare system        | 0.75 0.55–1.01 0.79          | 0.42–1.47                                   | 0.79 0.54–1.15 0.76                      | 0.35–1.64                     |
| 8. Ability to find good health information| 0.72* 0.53–0.97 1.02         | 0.53–1.95                                   | 0.73 0.51–1.05 1.00                      | 0.46–2.21                     |
| 9. Understanding health information        | 0.84 0.61–1.17 1.49          | 0.75–2.99                                   | 0.80 0.53–1.20 1.09                      | 0.47–2.50                     |

All analyses are adjusted for age, gender, cohabitation, mother tongue, and education.

*: P < 0.05.

CI, confidence interval; HLQ, Health Literacy Questionnaire; OR, odds ratio.

Ethics and approvals

The study was approved by the Danish Data Protection Agency (j.no: 2016-051-000001(1321)). According to Danish law, when survey-based studies are undertaken in accordance with the Helsinki Declaration, specific approval by an ethics committee and written informed consent is not required. Potential respondents were provided with information about the survey and its purpose, including that participation was voluntary. The completion of the survey by participants was considered implied consent.

Results

A total of 490 individuals provided data for this study. Table 1 describes the socio-demographic and health related characteristics of the total sample as well as by clusters and subgroups. The population had a mean age of 50.5 years (SD 17.3), the majority were females (60%) and few (7%) had another language than Danish as their mother tongue. One in five (19%) lived alone and the same proportion (19%) had low education. Reflecting the recruitment at health facilities, 45% of the sample reported low health status and 41% and 19% reported long-term illness and multimorbidity, respectively.

In this sample, five clusters were selected as the optimal cluster solution for the sample, based on cluster size and health literacy pattern diversity. Cluster analysis revealed a pattern of high (Cluster A) through to low (Cluster E) overall health literacy based on overall mean of the nine HLQ scale scores. Nineteen respondents had one or more missing HLQ scores due to incomplete questionnaire data and were excluded from the clustering procedure.

The likelihood of having lower education increased from Cluster A (representing highest overall health literacy) through Cluster E (representing lowest overall health literacy) (χ² = 4.08 (4), P = 0.395). Cluster A was characterized by a significantly larger proportion reporting good health status (χ² = 39.976 (4), P < 0.001) and well-being (χ² = 28.832 (4), P < 0.001) than other clusters. Cluster B and C was characterized by a significantly higher number without a long-term condition (χ² = 18.641 (4), P < 0.001) and Cluster D had a higher percentage of people with poor health (χ² = 39.976 (4), P < 0.001) and long-term conditions (χ² = 18.641 (4), P < 0.001). Cluster E was too small to produce significant differences but was generally characterized by poor health indicators.

Besides the expected high prevalence of poor health indicators, individuals in the two subgroups were on average older, more often lived alone and more often had low education than the total population.

Table 2 shows the result of a regression analyses, representing the associations between each HLQ scales and the subgroups.

In regression analyses, adjusted for age, gender, cohabitation, ethnicity and education we found that a one-unit increase in mean scale score of ‘healthcare provider support’ (Scale 1) increased the odds of having a long-term illness [odds ratio, OR 2.97 (1.78–5.08)]. Conversely, a one-unit increase in Scale 3...
‘actively managing my health’ and Scale 4 ‘social support for health’ decreased the odds [OR 0.53 (0.31–0.9) and OR 0.43 (0.24–0.74), respectively] of having a long-term illness in both unadjusted and adjusted analyses.

Significant associations between multimorbidity and the same three HLQ scales (Scale 1, 3 and 4) were also seen in adjusted analyses [OR 2.94 (1.53–5.87), OR 0.51 (0.26–0.98) and OR 0.33 (0.17–0.62), respectively].

In unadjusted analysis ‘having sufficient health information’ (Scale 2) was significantly associated with both groups [OR 0.51 (0.36–0.72) and OR 0.55 (0.36–0.84)], while the result retained its directionality but failed to reach significance in adjusted analysis. Table 3 shows the mean scale score and SD for each of the nine HLQ subscales upon which the cluster analysis is based. Results are given for the total population as well as for each cluster separately.

In all HLQ subscales, Cluster A scored well above the total population. The same was true of mean HLQ scale scores in Cluster B. However, for social and health care provider support as well as appraisal of health information and active management of health, mean scores dropped compared with Cluster A. Cluster C mean HLQ scale scores were very similar to those of the total population. Cluster D mean HLQ scale scores were lower than total population means and especially low with regard to social support, ability to engage with health care providers and ability to navigate the health system. The small Cluster E had very low mean HLQ scores in all scales.

### Discussion

In this study, we have provided evidence that long-term illness and multimorbidity is associated with specific health literacy challenges including lack of active self-management, and social support for health independent of age, gender, cohabitation, ethnicity and education. Further, we have provided a comprehensive profile showing health literacy strengths and weaknesses of a Danish population.

### Strengths and weaknesses

To our knowledge, this is the first study to provide a comprehensive health literacy profile based on the HLQ of a Danish population and the first HLQ profile to compare the health literacy of a general population (i.e. not grouped based on health status) with those of people with long-term illness and multimorbidity. Our analyses allowed us to confirm the vulnerability of these subgroups and further characterize their specific health literacy assets and challenges.

Obviously, low health literacy decreases the respondents’ abilities to provide the data required in a questionnaire. Also, awareness of personal challenges may increase the likelihood to decline participation. The issue has been minimized by the supported data collection with face-to-face invitation and interview but may have lead to an underestimation of the health literacy challenges in the population. The strength of our results has been affected by the relative low sample size resulting in small clusters and groupings, most prominently in Cluster E (n = 22). Also, since health literacy is a dynamic capacity affected by personal, environmental and health-related factors, knowledge about causal pathways and the experienced nature of the specific challenges are important information not obtained in this cross-sectional study.

Confirmatory studies using the same approach on larger populations in other similar contexts, as well as longitudinal or qualitative research prior to or as part of specific intervention development is warranted.

### Interpretations

The association between poor health and low health literacy has been shown in multiple studies. Our regression analyses confirms these findings, and provides additional information as to what aspects of health literacy may be most severely challenged.

In our cluster analysis, we also found a strong tendency towards poor health indicators in clusters with poor health literacy profiles (Cluster D and E). This is concerning since people with poor health have relatively greater need of health literacy competencies. In Cluster D, for instance, we found a lack of ability to engage with health care providers putting great emphasis on the provider’s initiative and support.

Both clusters also exhibit a high proportion with low education, and Cluster E is characterized by a high proportion aged above 60 years and a high proportion of men. These are all factors previously associated with low health literacy and may indicate a need for less complex information and more individualized services in these groups.

Clusters with above average health indicators (Cluster A and B) exhibited high mean scores in all nine HLQ scales. However, in spite of having the most advantageous health literacy profile especially regarding social and healthcare provider support for health (HLQ scale 4 and 1) and the ability to manage health (HLQ scale 3), persons in Cluster A have often had poor health indicators than persons in Cluster B. Further studies should examine if these
findings are dependent of disease length and severity and represents a window for effective health literacy interventions in the earlier or milder phases of certain diseases. Some indication of the latter was found in our regression analysis, where a strong sense of support from health care providers (HLQ scale 1) was associated with major health challenges such as long-term illness and multimorbidity. In these groups, however, the benefit of such support was not reflected in the experienced level of information and knowledge (HLQ scale 2) and the individual health management (HLQ scale 3). These findings are consistent with other studies that have found general associations between health literacy and multimorbidity as well as long-term illness.5,8,30 In these studies, knowledge and self-management is not directly included as a health literacy competence, but several studies have linked functional health literacy, health knowledge and self-management skills with health outcomes.16,31–33

Considering the older mean age and increased prevalence of single living among the subgroups with long-term illness and multimorbidity, the negative association with social support (HLQ scale 4) in our study is not surprising. It does, however, have implications for the development of health literacy sensitive interventions and services in these groups, since the importance of distributed health literacy to mitigate the consequences of low health literacy is well-established.34,35 Based on that, we would recommend systematic involvement of relatives or substituents such as professional or voluntary companions in initiatives targeting similar populations.

Generalizability

Any differences between our study population and the general Danish population may affect external validity. As a possible consequence of the convenience sampling, e.g. in health facilities and the possible differences in likelihood of participation between specific groups our study population is characterized by a higher prevalence of females, elderly people, people who live with someone and people with poor health indicators, but with a comparable educational level to the general Danish population (table 1).36,37 No statistics are available regarding the mother tongue of the general Danish population; however, approximately 14% are immigrants or descendants of immigrants.57 Any comparison of our results with similar studies in other countries with comparable health systems and socioeconomic status, should consider these differences. HLQ based surveys in populations with specific health characteristics generally support the validity of our associative results,38,39 and confirm some of the socio-demographic characteristics we found among people with health literacy challenges.6,38,39

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Key points

- Having a long-term illness or multimorbidity increases the likelihood of experiencing specific health literacy challenges such as active self-management.
- Health literacy may prove an important modifiable mediator of inequality in health outcomes among people with long-term and multiple illnesses.
- Health literacy profiling provides a potential starting point for the development of effective interventions that aim to improve health literacy responsiveness and ultimately health outcomes.

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Background: Many adolescents experience mental health problems which may have serious consequences for short- and long-term health and wellbeing. This study investigates socioeconomic inequality in emotional symptoms, self-efficacy and social competence. Further, whether self-efficacy and social competence reduce socioeconomic inequalities in emotional symptoms. Methods: Data stem from the cross-sectional Danish Health Behaviour in School-aged Children Methodology Development Survey 2012. Data were collected among all schoolchildren in grades 5–9 (11–15-year-olds) in 23 public schools in two municipalities. Participation rate was 76.8% (n = 3969). Analyses of the associations between daily emotional symptoms, occupational social class, self-efficacy and social competence were performed through logistic regression analyses using SAS version 9.3. Multilevel logistic regression analyses were used to study effect modification. Results: Schoolchildren from lower socioeconomic positions have higher odds for daily emotional symptoms and lower levels of high self-efficacy and high social competence compared to schoolchildren from higher socioeconomic positions. High self-efficacy and high social competence buffer the association between socioeconomic position and emotional symptoms, i.e. they seem to protect children and adolescents from lower socioeconomic strata against the higher risk of daily emotional symptoms. Conclusions: High self-efficacy and high social competence buffer the negative effects of low socioeconomic status on emotional symptoms among schoolchildren. Self-efficacy and social competence can be promoted e.g. through school-based initiatives and may be an effective way to improve mental health and reduce socioeconomic inequality in emotional symptoms among children and adolescents.

Self-efficacy and social competence reduce socioeconomic inequality in emotional symptoms among schoolchildren

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