LOW HEALTH LITERACY AND EXCESS BODY WEIGHT: A SYSTEMATIC REVIEW

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SUMMARY

Objective: There is recent evidence that poor health literacy (HL) could be implicated in the aetiology of obesity and could be an important reason behind obese people's inability to encounter difficulties in overcoming obesity issues. The current study reviews the recent scientific evidence investigating the possible link between poor HL levels and excess body weight in adults and children.

Methods: The authors performed a thorough systematic computer-assisted literature search from 1 January 2005 up to 31 May 2017. Only English original studies in healthy people, investigating the relationship between HL and excess body weight, were included.

Results: Twenty-two studies in total were included in this literature review, 17 studies were conducted in adults and 5 in children. In 17 out of 22 studies reviewed, low HL was significantly associated with increased body mass index, overweight and obesity. In case of children and adolescents, the above association seems to be more consistent compared to adults.

Conclusion: There is good evidence that low levels of HL are associated with excess body weight, particularly in children. Initiatives to improve health literacy levels could be a useful tool in the management of the obesity epidemic.

Key words: health literacy, obesity, excess body weight, children, adults

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INTRODUCTION

Obesity is a widespread problem with major public health implications, however, it has not been yet adequately prevented or treated. In general, poor health literacy is associated with poor health behaviours and outcomes. There is recent evidence, that poor health literacy (HL) could be implicated in the aetiology of obesity and, most importantly, could be an important reason behind obese people's inability to encounter difficulties in overcoming obesity issues (1).

According to the World Health Organization (WHO) health literacy is defined as "The cognitive and social skills which determine the motivation and ability of individuals to gain access to understand and use information in ways which promote and maintain good health" (2). Another term usually used in the literature is the one by the Institute of Medicine of the National Academies, describing HL as "the individuals' capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions" (3). Poor HL simply translates to a lack of understanding one's own wellbeing, of what can be done to improve it, and of what help the healthcare system can offer. In addition to overweight and obesity (1, 4, 5), low levels of HL have also been associated with several adverse health outcomes such as increased overall mortality (6), higher rates of hospitalization, reduced use of preventive health care services (7), low levels of compliance with prescription medicines (8), difficulty in communication with health professionals (8), poorer knowledge about illness, and lack of the necessary management skills to control chronic diseases (9). It is important to note that low levels of HL, as it can be expected, are associated with most major chronic degenerative diseases such as hypertension (10), diabetes (11), and depression (12). Health literacy, however, can be improved and therefore is a potentially amenable determinant of health.

Measuring Health Literacy

There are many different instruments specifically designed to measure HL (13), focusing on different aspects of the definition of HL, hence, making direct comparison between different studies measuring HL relatively difficult. The most frequently used measures for HL assessment are the Rapid Estimate of Adult Literacy in Medicine (REALM) which measures reading ability and pronunciation (14), the Test of Functional Health Literacy in Adults (TOFHLA) which measures reading, comprehension and numeracy (15), and the Newest Vital Sign (NVS) which measures comprehension and numeracy using the food label of an ice cream (16). Finally, in recent years, a new tool seems to gain ground in HL measurement. This tool is the European Health Literacy Survey Questionnaire (HLS_EU_Q47), which was developed for the European Health Literacy Project in which 8 European countries participated (17). The aim of this paper was to review the most recent scientific evidence linking poor HL levels with excess body weight in adults and children.

MATERIALS AND METHODS

Data Sources

Using a computer-assisted literature search (Medline via PubMed and Scopus), original-research studies that were published in the English language between 1 January 2005 and 31 May 2017 were selected. Combinations of specific keywords were used by the researcher in order to find appropriate articles. The following keywords were used: "health literacy" and "obesity", or "BMI", "body mass index", "body weight", "energy balance", "abdominal obesity", "weight management". In addition, the reference lists of the retrieved articles directed the search to relevant present articles that were not allocated through the searching procedure. Only original studies in the English language have been selected for this review. The initial search resulted in 758 studies both in PubMed and Scopus and we used a hierarchical approach based on title, abstract and full text, in order to assess the relevance of the studies. Exclusion criteria were the use of another language except English, not being an original study such as reviews, case studies etc., and patients with chronic or incurable diseases. In total, 22 studies were included in the current review (17 cross-sectional, 2 randomized control trials (RCT), 1 cohort study, 1 intervention, and 1 mixed method – this study included qualitative and quantitative procedures with seven focus groups and a survey).

RESULTS

Low Health Literacy and Excess Body Weight

The studies reviewed in the current paper were separated into studies for adults (over 19 years of age), and study sample size ranged from n=78 to n=162,209 participants. Twelve studies took place in the United States, 5 in Asia, 3 in Europe, 1 in the United Kingdom, and 1 in Australia. It is important to note that research on HL and obesity in Europe is relatively limited, judging from the relatively scarce scientific literature in the above field published by European authors.

In 17 out of 22 studies reviewed, low HL was significantly associated with increased body mass index, overweight and obesity (4, 5, 18–32). However, quite a few studies failed to support the above finding. Only one study was found, that linked lower levels of HL with lower BMI, and it was conducted in an elderly population. In the prospective cohort study by Baker et al. conducted in 3,260 elderly people (age > 70 years), levels of adequate HL were 64.2%, marginal HL were 11.2% and inadequate HL were 24.5%. Participants with inadequate HL were more likely to be underweight (BMI < 18.5 kg/m^2) (33). It is highly likely that, in the elderly, low health literacy translates to higher risk of nutritional deficiencies and poor nutritional status, however, further studies are needed to investigate the above hypothesis.

Studies in Adults

From 22 studies that were included in this review, 17 assessed HL levels and body weight in adults (Table 1). In 12 out of 17 studies, levels of HL were associated negatively with body weight. According to these studies, as HL levels increased, body weight was reduced and vice versa. However, 5 of these studies did not manage to find any relationship between HL and body weight (34–37).

In all studies, except one, body mass index was calculated for assessing overweight or obesity. In the study where BMI was not calculated, researchers assessed only participants' weight, which is a limitation of the study with respect to assessing obesity (6). Weight and height were measured in 5 studies, whereas in 12 studies, these variables were self-reported. As far as HL measurements are concerned, the most commonly used tools were the NVS and the REALM (4 occasions each), followed by S-TOFHLA (2 occasions), the single self-reported health literacy item: ''How confident are you filling out medical forms by yourself?'' (2 occasions), and the validated three-item HL screening measure which includes the following 3 questions: ''How often do you have someone help you read hospital materials?''; ''How confident are you filling out medical forms by yourself?''; ''How often do you have problems learning about your medical condition because of difficulty understanding written information?'' (2 occasions). Two distinct health literacy dimensions from the 9-dimension Health Literacy Questionnaire (HLQ), the Chinese Citizen Health Literacy Questionnaire, the Health Literacy Management Scale and the European Questionnaire on Literacy for Health (LHS-EU-PT) validated in Portuguese were used once each.

Zoellner et al. wanted to examine whether HL status in employees moderated reach, retention and weight outcomes in a weight loss programme. A two-group cluster randomized controlled trial was implemented which included two 12-month weight loss interventions. The first one was the INCENT programme. Participants had the opportunity to receive daily emails with information about eating and exercise behaviour, they could visit a web site which was targeting weight loss with specific behavioural tools, a kiosk to track weight and their process, and they received some money as a motive for their participation. The other intervention was the LMW programme, which included 4 newsletters and 4 sessions of 1 hour each, using some of the material of the INCENT programme. Each of these procedures occurred once every 3 months. The sample size consisted of 1,460 employees from the USA, ≥18 years old, with a body mass index >25 kg/m^2. HL significantly moderated the weight loss effects. Specifically, when HL reduced one-unit point, greater weight loss in INCENT compared to LMW was noticed, especially for those with lower baseline HL. Some of the main limitations of the study were the high HL status of the sample and subjective HL measure that was used (4).

In another study by Lanpher et al. a randomized control trial was conducted in 194 overweight and class I obese black women, 25–44 years old, from North Carolina, USA. The aim of the study was to examine differences in socio-demographic, clinical characteristics and weight by HL. Participants randomly assigned either into usual care or into an intervention programme, named Shape Program, which consisted of a 12-month intervention in order to prevent weight gain. Initially, over 50% of the sample had low HL. Contrary to the results of the previous study, HL did not affect positively weight change after the implementation of the 12-month intervention. This study had several limitations such as the small sample, the aim of the study that was to prevent weight gain, and as a result the variability of weight change is not as that we use to see in weight loss trials, and HL was assessed in

Table 1. *Studies in adults*

	Reference and year of publication	Country	Study type	Sample (N, sex, ethnicity)	Measures for health literacy	Obesity assessment	Results
1	Al-Ruthia et al., 2017	Saudi Arabia	Cross-sectional	N = 127 Women with PCOS Arab ≥ 18 years old	Health literacy (HL) was assessed using the Arabic version of the single item literacy screener (SILS), which consists of a single question: "How confident are you filling out medical forms by yourself?"	BMI was retrieved from patients' electronic medical records.	Participants with high BMI were 9.6% less likely to have a good health literacy level.
2	Friis et al., 2016	Denmark	Population-based study	N = 29,473 Both sexes Caucasian ≥ 25 years old	Two distinct health literacy dimensions from the 9-dimension Health Literacy Questionnaire (HLQ) were used: (a) Understanding health information well enough to know what to do and (b) Actively engage with health care providers.	Self-reported height and weight were used to calculate body mass index, and obesity was defined as a body mass index of 30 kg/m^2 or more.	Both health literacy scales were significant mediators in the association between education and obesity.
3	Geboers et al., 2016	Netherlands	Cohort study	N = 3,241 Both sexes Caucasian ≥ 65 years old	Health literacy was measured using three self-report screening questions. "How often do you have someone help you read hospital materials?" "How confident are you filling out medical forms by yourself?" "How often do you have problems learning about your medical condition because of difficulty understanding written information?"	BMI was calculated using the length and weight of the participants as objectively measured at the research site. BMI was dichotomized as obese (BMI over 30) or non-obese.	Statistically significant associations of low health literacy in older adults with obesity were found.
4	Lanpher et al., 2016	United States	Randomized control trial	N = 194 Overweight and class I obese women Black women 25–44 years old	Newest Vital Sign	Participants changed into medical gowns and removed their shoes for physical measurements. Study staff measured participants' height to the nearest 0.1 cm with a wall-mounted stadiometer. Weight was measured to the nearest 0.1 kg using an electronic scale. BMI was calculated by dividing weight in kilograms by height in centimeters squared.	There was no effect of health literacy on 12-month weight change.
5	Zoellner et al., 2015	United States	Two-group cluster randomized controlled weight loss trial	N = 1,460 employees Both sexes 78% white and 19% African-American ≥ 18 years old	A validated three-item HL self-reported screening measure in which participants rate perceptions of their HL skills on a five-point Likert scale. Items focused on the degree to which people need help in reading healthcare materials, have difficulty understanding written materials, and can confidently complete medical forms.	Weight was objectively assessed with a calibrated scale and built-in digital camera that captured the employees' image at baseline and at a 12-month follow-up.	HL moderated weight loss effects and losing > 5% weight. HL influences reach and moderates weight effects.

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Table 1. *Studies in adults (continued from the previous page)*

	Reference and year of publication	Country	Study type	Sample (N, sex, ethnicity)	Measures for health literacy	Obesity assessment	Results
6	Lassetter et al., 2015	United States	Cross-sectional	N = 364 Both sexes Hawaii n = 209, Utah n = 155 ≥ 18 years old	Newest Vital Sign	Each participant was measured fully clothed, weight and height was measured with a digital Seca 803 scale and a Seca 213 stadiometer, respectively. We weighed each participant twice. If weights differed, we weighed the participant a third time and averaged the three results for use in calculating BMIs.	Lower NVS scores were associated with increased BMI.
7	James et al., 2015	United States	Mixed method study	N = 413 Women African American women ≥ 18 years old	HL was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM), a reading recognition test that provides quick, valid assessment of a person's HL.	Women were weighed barefoot with indoor clothing on a digital scale and height was measured with a stadiometer. BMI was calculated based on participants' weight and height.	Women with LHL were significantly more likely to have a higher body mass index (BMI) than those with AHL.
8	Liu et al., 2015	China	Cross-sectional	N = 1,452 Both sexes Chinese adults 60–99 years old	Chinese Citizen Health Literacy Questionnaire	BMI	No differences were noted between the health literacy score and BMI.
9	Buckley et al., 2015	United States	Intervention	N = 126 Both sexes Caucasian ≥ 16–79 years old	Authors' own	BMI	Nearly 90% demonstrated improved health literacy. At the onset of the programme, 54% of participants were considered to be obese, and at the close of the eight-week programme, the rate of obesity among all participants decreased to 46.0%. The average participant experienced a 3.7-pound weight loss, which correlated with an average BMI decrease of 0.7 kg/m^2, from 31.5 to 30.8.
10	Joshi et al., 2014	Australia	Cross-sectional	N = 739 patients Both sexes Australian 75.3% and others 24.7%, 40−69 years old	Health Literacy Management Scale	BMI	Patients with insufficient health literacy were more likely to report being overweight or obese.
11	Song et al., 2014	United States	Cross-sectional	N = 131 Both sexes African-Americans 50.0%, White, non-Hispanic 36.2%, others 13.8%, 18−69 years old	Newest Vital Sign	BMI calculated from self-reported height and weight.	Compared to the healthy weight group, the proportion of participants with an adequate level of health literacy in the overweight and obese groups was lower and the intergroup difference was marginally statistically significant.

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Table 1. *Studies in adults (continued from the previous page)*

	Reference and year of publication	Country	Study type	Sample (N, sex, ethnicity)	Measures for health literacy	Obesity assessment	Results
12	Mõttus et al., 2014	Scotland	Cross-sectional	N = 730 Both sexes Caucasian older people	Rapid Estimate of Adult Literacy in Medicine (REALM), Shortened Test of Functional Health Literacy in Adults (S-TOFHLA), and Newest Vital Sign (NVS)	Weight and height, used for calculating BMI (weight in kilograms/height in meters^2) were measured at the clinic visit.	Lower REALM, S-TOFHLA and NVS scores were associated with worse scores on all health outcomes. Lower levels of health literacy, as measured by its three most common tests, were associated with greater BMI.
13	Cunha et al., 2014	Portugal	Cross-sectional	N = 508 Both sexes Portuguese 18–93 years old	European Questionnaire on Literacy for Health (LHS-EU-PT) validated in Portuguese	BMI	It was found that overall 73.62% of the participants have an inappropriate and problematic level of literacy for health. Participants with inadequate LH are those with higher BMI.
14	Sentell et al., 2011	Hawaii	Cross-sectional	N = 5,399 Both sexes White and Asian-American-Pacific Islanders ≥ 18 years old	A single self-reported health literacy item: "How confident are you filling out medical forms by yourself?"	BMI	Low health literacy was not significantly associated with obesity/overweight in any group in adjusted models.
15	Huizinga et al., 2008	United States	Cross-sectional	N = 160 primary care patients Both sexes White and non-white ≥ 18 years old	Rapid Estimate of Adult Literacy in Medicine (REALM)	BMI	Literacy was not correlated with BMI.
16	Wolf et al., 2007	United States	Cross-sectional	N = 2,923 Both sexes White, African-American, Spanish, others ≥ 65	The short version of the Test of Functional Health Literacy in Adults (S–TOFHLA)	Self-report height and weight for BMI	No significant differences were noted by mean body mass index and health literacy. Inadequate health literacy was not found to be significantly associated with any of the health risk behaviours investigated.
17	Sudore et al., 2006	Memphis, Tennessee, and Pittsburgh, Pennsylvania	Cross-sectional	N = 2,512 Both sexes Black and white older people > 70 years old	Rapid Estimate of Adult Literacy in Medicine	BMI	Participants in the lower literacy categories were more likely to have obesity.

Table 2. *Studies in children*

	Reference and year of publication	Country	Study type	Sample (N, sex, ethnicity)	Measures for health literacy	Obesity assessment	Results
1	Shih et al., 2016	Taiwan	Population-based survey	N = 162,209 Both sexes Taiwanese 11–12 years old school children	Taiwan Child Health Literacy	BMI was calculated using height, weight, age and gender and using the extended International Body Mass Index Cut-offs proposed by the International Obesity Task Force (IOTF) and modified for Asian body types.	Children in the highest health literacy quartile were less likely to be obese compared with the lowest quartile. After controlling for gender, ethnicity, self-rated health, and health behaviours, children with higher health literacy were less likely to be obese and underweight.
2	Mo et al., 2016	Rural China	Cross-sectional	N = 735 Both sexes Chinese children aged 3−6 years	Health literacy was assessed using 14 questions about the awareness of healthy parenting taken from a survey entitled the Health Literacy of the Chinese Public: Basic Knowledge and Skills.	The height of children was measured with a stadiometer (accurate to 1.0 cm). Weight for the children was measured with a digital electronic scale (accurate to 0.1 kg). A child's body mass index (BMI) was calculated using the formula of weight in kilograms divided by height in meter^2, and a child's weight-for-height Z-score (WHZ) and BMI-for-age Z-score (BAZ) were also calculated. According to the WHO Child Growth Standards a WHZ below 2 indicates wasting while a BAZ over 2 indicates overweight.	This study found a relatively high prevalence of wasting, overweight and obesity among left-behind children. After potential confounders were controlled for, the parenting pattern, annual household income and health literacy of the primary caregiver significantly influenced the health and developmental indicators of children. Health literacy and overweight were statistically significant, negatively correlated.
3	Lam et al., 2014	China	Population-based cross-sectional health survey	N = 1,035 Both sexes Chinese high school students aged 12–16 years	Chinese version of the short form of the Test of Functional Health Literacy	Overweight and obesity were assessed in accordance to the recommendation of the World Health Organization (WHO) Global Database of Body Mass Index classification methods.	After adjusting for potential confounding factors and the cluster sampling effect, low health literacy was significantly associated with overweight and obesity.
4	Chari et al.,2014	United States	Cross-sectional	N = 239 English-speaking child-parent dyads Both sexes African-American and White 7–19 years old children	Newest Vital Sign	The BMI was calculated according to the formula kg/m^2, and BMI percentile was obtained using CDC growth charts.	For children, the odds of obesity decreased with higher parent NVS. For adolescents, odds of obesity were higher for adolescents with the lowest category of NVS. Obesity in school-aged children was associated with parental factors (obesity, parental HL); obesity in adolescents was strongly associated with the adolescent's HL.
5	Sharif et al., 2010	United States	Cross-sectional	N = 78 Both sexes African-American, Latino, White children 6–19 years old	Short Test of Functional Health Literacy (STOFHLA)	We used a body composition analyzer Scale to weigh each subject. Height was measured using a stadiometer. We entered child age, gender, height, and weight into Epi-Info 2002 nutritional analysis program, to calculate BMI Z-scores.	Child STOFHLA correlated negatively with BMI Z-score. After adjusting for confounders, child STOFHLA was independently associated with child BMI Z-score.

the 18 months visit only by NVS, a tool that may not be sensitive to middle levels of HL (34).

It is worth mentioning that a study which aimed at examining the relationship between BMI and HL among women with polycystic ovary syndrome (PCOS) was included in this review. This very recent cross-sectional study, published in 2017 by Al-Ruthia et al., included women of mean age 27.40 years (± 5,35). HL was assessed by the Arabic version of the single item literacy screener (SILS), which consists of a single question: ''How confident are you filling out medical forms by yourself?''. After controlling for confounding factors such as age, education etc., PCOS patients with higher BMI were almost 10% less likely to have good HL compared to others with lower BMI. The limitations of this study were the use of only one HL item and that the results cannot be generalized due to the study design (18).

Studies in Children and Adolescents

Five from 22 studies in this review assessed HL levels and body weight in children and adolescents up to 19 years of age (Table 2) (28–32). In case of children and adolescents, the possible association between low health literacy and excess body weight seems to be more consistent. More specifically, all the studies conducted in this age group and included in this review found a significant association of low HL levels with overweight and obesity. In 2 studies, parental HL was assessed in order to investigate if there is a link with child's body weight, and in the remaining 3 studies, child's HL was assessed. In all 5 studies, weight and height were measured and body mass index was calculated for assessing overweight or obesity. The instruments to assess HL differed a lot. The STOFHLA was used in 2 studies and NVS, Taiwan Child Health Literacy and 14 questions about the awareness of healthy parenting taken from a survey entitled the Health Literacy of the Chinese Public: Basic Knowledge and Skills, were used once each.

An interesting population-based study occurred in Taiwan by Shih et al. The sample was particularly large (n = 162,209) and consisted of Taiwanese 11–12 years old school children. HL was assessed by the Taiwan Child Health Literacy measure and BMI was calculated using height, weight, age and gender in accordance with the extended International Body Mass Index Cut off points, proposed by the International Obesity Task Force (IOTF) and modified for Asian body types. Results showed that children with higher HL were less likely to be obese and underweight (28).

DISCUSSION

The purpose of the current literature review was to investigate the evidence linking poor HL levels with excess body weight in adults and children. The majority of the studies included in this review indicate that low levels of health literacy are associated with excess body weight. This association seems to be more profound in case of children and adolescents in comparison to adults.

In a similar paper by Faruqi et al., which systematically reviewed primary health care level interventions targeting health literacy, in order to assess their effect on weight loss, the majority of the studies reviewed (11 out of 13 studies) resulted in a significant reduction in weight and/or BMI, in at least one follow-up visit (1). Another systematic review by Sansom-Daly et al., which included studies for health literacy in adolescents and young adults, also concluded that poorer health literacy was associated with some adverse health outcomes, one of which was obesity (38).

Low levels of SES are associated with obesity in developed countries, especially in women (39). In the current review, in 9 out of 22 studies in total, there was a significant negative correlation between HL levels and socioeconomic status (SES). More specifically, SES was examined and the results indicated that low levels of HL were more likely to occur in participants with lower education, lower income and lower occupational social class. However, the interrelationships between SES, HL and obesity, were not examined in these studies. As for the race and ethnicity, Caucasian participants were more likely to have higher levels of HL than the remaining groups (5, 24–27, 31, 34–36).

There is evidence that HL and excess body weight are negatively associated, however, there are discrepancies in the findings of the studies reviewed in this paper, particularly in the adult population. This could partly be attributed to a number of limitations of the studies with respect to the methodology, the sampling method and different methods used to assess HL. A major problem, that the concept and measurement of health literacy has, is the heterogeneity of HL measurements used. Health literacy, due to its multidimensional construct, has many definitions and theoretical frameworks and the result is the lack of a gold standard measure. More than 50 tools for measuring HL exist (13), but each of them measures only some aspects of HL. Also, every tool seems to have psychometric weaknesses. For example, when some of these tools, such as the REALM, TOFHLA and NVS, are given to the participants at the same time, the results are different in terms of HL levels (40). This renders the comparison between the studies' results difficult. Moreover, another important limitation of this review is that in more than half of the studies participants' weight and height were self-reported.

CONCLUSIONS

There is evidence that low HL could be implicated in the aetiology of obesity and could be an important reason behind obese people's inability to succeed in loosing excess body weight or maintaining normal weight status. Improving health and nutrition literacy could empower people to effectively manage long-term health conditions and reduce the burden on health and social care services. More specifically, increasing health literacy levels might be a useful tool in better managing the obesity epidemic in Europe and worldwide.

More studies, particularly in Europe, are needed to better elucidate the possible interrelationships between HL levels and excess body weight in different populations in order to better understand the role of increasing health literacy in maintain healthy lifestyle factors and good health.

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Conflict of Interests

None declared

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