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Article

Associations between health-related skills and young adults' work ability within a structural health literacy model

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Summary

Young adults have a high societal relevance but are still an under-represented target group in health promotion. Health literacy is widely acknowledged as one of the strongest predictors and key determinant of health, so its influence on work ability is of great interest. The purpose of the study was to examine the associations between health-related skills and work ability within the structural model of health literacy of Lenartz, Soellner and colleagues, which explains health behaviour and health through the indirect and direct influence of six 'advanced skills' ('self-perception', 'proactive approach to health', 'dealing with health information', 'self-control', 'self-regulation' and 'communication and cooperation'). The cross-sectional study was based on baseline data of a health literacy promotion intervention (495 vocational school students, 59.0% female, age span 18–25 years). Structural equation modelling with partial least squares was used to examine the associations between the six constructs of the model and the Work Ability Index (WAI). Mean WAI score was 39.7 ± 4.5 (51.1% categorized 'moderate'/'poor'). Five out of six constructs of the model showed a statistically significant indirect or direct effect, respectively, on work ability. The model explained 24.8% of the WAI score variance. Our findings show associations between the health literacy model and the work ability among young employees. In view of demographic change, it is crucial to develop and analyse target group-specific health literacy interventions. The model offers new facets in the modelling of health literacy.

Key words: health literacy, work ability, emerging adulthood, PLS-SEM, cross-sectional

INTRODUCTION

Young adults are a special subgroup of employees who are in the critical phase of 'emerging adulthood' (age span 18–25 years), in which they face new challenges such as increased autonomy, responsibility and exploration of possible life directions (Arnett, 2000). Both healthy and unhealthy behaviours manifest in this phase (Due *et al.*, 2011; Daw *et al.*, 2017; Lawrence *et al.*, 2017) and studies report, e.g. decreasing physical activity (Corder *et al.*, 2019) and weight gain (Nelson

et al., 2008). Nevertheless, about a good eight to nine-tenths of young adults rate their subjective health status as 'very good'/'good' at the same time (Betz *et al.*, 2015; Statistisches Bundesamt, 2019).

In health promotion, young adults are still considered an under-represented target group (McVeigh *et al.*, 2016) and their work ability is comparatively little researched (Sumanen *et al.*, 2015). This is surprising because young employees face high expectations of their employers (Ilmarinen, 2009) and, due to the demographic change and their societal relevance, need good work ability over a long working life (Sumanen *et al.*, 2015). In view of the looming shortage of specialists (Bundesministerium für Arbeit und Soziales, 2017), it appears fundamental to improve young employees' work ability. In general, reduced work ability is linked to productivity loss (van den Berg *et al.*, 2011), an increased risk of long-term sickness absence (Reeuwijk *et al.*, 2015) and premature exit from working life (Sell *et al.*, 2009).

In consequence, young employees' health literacy becomes increasingly important. The concept of health literacy, first introduced in education (Simonds, 1974), has evolved from handling words and numbers in a primarily medical context (Davis *et al.*, 1991; Parker *et al.*, 1995) to a broader, more complex understanding with a range of definitions due to interdisciplinary perspectives (Pleasant and Kuruvilla, 2008; Berkman *et al.*, 2010; Ploomipuu *et al.*, 2019).

Health literacy is seen as a key outcome from health promotion and education (Nutbeam, 2000; St Leger, 2001; Sanders *et al.*, 2009). At the individual level, health literacy is understood as ability to make independent health-related decisions based on knowledge, motivation and skills to access, understand, evaluate and apply health information, thereby linking it to individual empowerment (Nutbeam, 2000; Ratzan and Parker, 2000; Peerson and Saunders, 2009; Sørensen *et al.*, 2012). Today, health literacy is widely acknowledged as one of the strongest predictors and key determinant of health (World Health Organization, 2013) and as an essential life skill (Kickbusch, 2008). Although limited health literacy is more frequent among older aged (Paasche-Orlow *et al.*, 2005; Sørensen *et al.*, 2015; Schaeffer *et al.*, 2017), 47.3% of the 15–29 year olds in the German subsample of the European Health Literacy Survey (HLS-EU) study showed limited levels of health literacy (Berens *et al.*, 2016).

The positive impact of health literacy on individual's health is well documented: e.g. a higher health literacy is associated with healthier eating habits and non-smoking (Wagner *et al.*, 2007). Low health literacy is associated with poorer health outcomes and poorer use of health-care services (Berkman *et al.*, 2011) and higher prevalence of diabetes, heart disease or stroke (Adams *et al.*, 2009). Furthermore, people with a lower health literacy show lower levels of self-rated health (Wagner *et al.*, 2007; Sørensen *et al.*, 2015; Levin-Zamir *et al.*, 2016).

Starting from Nutbeam's broader understanding of health literacy as a public health approach that includes active and constructive handling of health-related information (Nutbeam, 2000), Lenartz, Soellner and colleagues developed a structural model of health literacy to provide a theoretical approach for improving health (behaviour) (Lenartz, 2012; Soellner *et al.*, 2017). The model, which focuses on concepts of behavioural psychology, integrates perceptive-motivational conditions and behavioural components as six 'advanced skills' (Figure 1). The validated model explains health behaviour and health through their indirect and direct influence (Soellner *et al.*, 2017).

The model was developed through expert input and concept mapping, followed by structural equation modelling (SEM) for the systematic building of a quantitative model based on questionnaire data ($n = 1173$) (Soellner *et al.*, 2010; Lenartz, 2012; Soellner *et al.*, 2017). Previous studies replicated the model with different target groups (Kuhlmann *et al.*, 2015; Fiedler *et al.*, 2018) and showed significant associations between its constructs and physical and mental health, health behaviour (Lenartz, 2012), absence of physical complaints (Kuhlmann *et al.*, 2015) and psychological well-being (Fiedler *et al.*, 2018).

Hence, the structural model offers an empirically derived approach to the concept of health literacy and it is hypothesized that the promotion of the included skills can lead to an improvement in health (Soellner *et al.*, 2017).

The influence of health literacy on work ability among young employees is of high interest. The purpose of this study was to verify the model structure in a sample of vocational school students in a first step. In a second step, the associations between the six constructs of the structural model of health literacy and work ability were examined.

METHODS

Study design and data sources

We conducted a cross-sectional analysis of baseline data of the WebApp study. WebApp was a web-based intervention study dealing with health literacy promotion among vocational school students (Grieben *et al.*, 2017). In Germany, vocational training is split into general schooling and occupation-specific teaching at apprenticing companies (alternating on a daily/weekly basis or

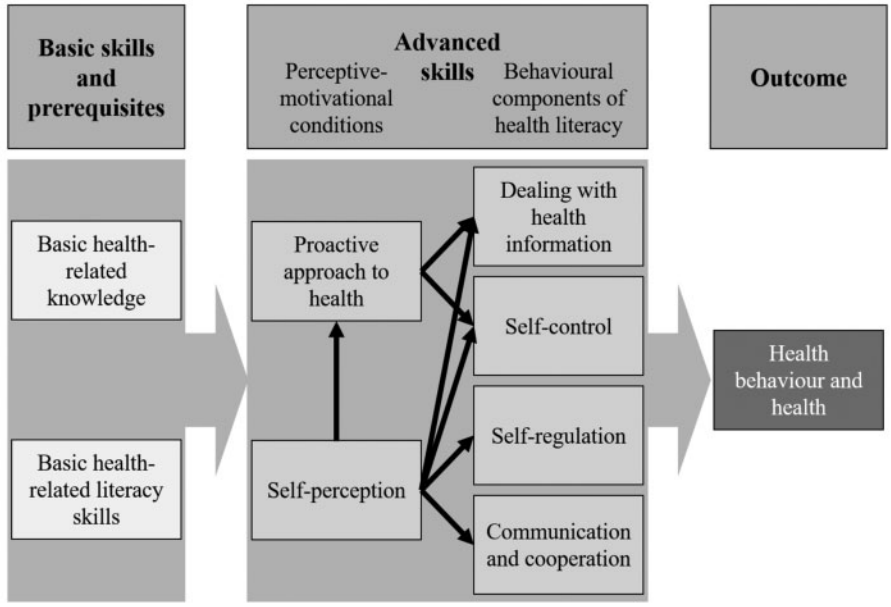

Fig. 1: Structural model of health literacy according to Lenartz (Lenartz, 2012) and Soellner *et al.* (Soellner *et al.*, 2017).

block by block) and normally lasts 3 years. All study participants were undergoing a commercial vocational training.

In co-operation with three vocational schools from different parts of Cologne, Germany, 33 vocational school classes were recruited.

The baseline measurements of the underlying study were conducted in February/March 2017 during regular school lessons and a school health project day, respectively (self-administered paper–pencil questionnaires). For the present analyses, all students aged 18–25 years were included following Arnett's conception of 'emerging adulthood' (Arnett, 2000). Data of underage students and participants of retraining courses outside the age span were not included. Consequently, in total, 495 cases were analysed ($N = 565$). Written informed consent was obtained from all participants of the sample.

Measures

Health literacy was measured using Lenartz's German questionnaire on health literacy (Lenartz, 2012). The questionnaire consists of 29 items depicting the six constructs (advanced skills) of the structural model (Lenartz, 2012; Soellner *et al.*, 2017) (Table 1 and Figure 1). All other (translated) questionnaire items are included in the supplemental digital content. The four response options per item are 'not correct at all', 'rather not correct', 'rather correct' and 'correct' (scale 1–4). The scores of each construct are calculated by generating the mean value of the belonging items (Lenartz, 2012). The questionnaire was shown to be a reliable (Cronbach's α for the six constructs: 0.70–0.89) and the underlying model was cross-validated with different samples (Lenartz, 2012; Soellner *et al.*, 2017).

Work ability was measured by the German short version of the Work Ability Index (WAI) (Hasselhorn and Freude, 2007). This instrument assesses work ability by contemplating the demands of work, the workers' health status and resources (Ilmarinen, 2007). The WAI consists of 10 items and seven dimensions that are summed up to a total score between 7 and 49. For young employees, Kujala and colleagues propose the following (re)classification: poor work ability (score 7–36), moderate (37–40), good (41–44) and excellent (45–49) (Kujala *et al.*, 2005). The test–retest reliability of the WAI is consistent (de Zwart et al., 2002). The internal (Eskelinen *et al.*, 1991) and the predictive validity regarding sickness absence has been established in the general population (Lundin *et al.*, 2017; Ohta *et al.*, 2017).

Additionally, data regarding sex, age and height and weight for body mass index (BMI) calculation were collected via self-reporting questionnaires.

Statistical analyses

Descriptive statistics (means, SDs and frequencies) were calculated to describe the questionnaire data.

Table 1: Constructs and example items from the questionnaire on health literacy

Constructs	Example item[a]
Perceptive-motivational conditions	
Self-perception (five items)	'If I feel uncomfortable, I usually know exactly why'
Proactive approach to health (five items)	'I take good care of my body'
Behavioural components of health literacy	
Dealing with health information (five items)	'Information about health is often unclear to me'
Self-control (five items)	'When working on a task, I can prevent my thoughts from constantly wandering off'
Self-regulation (five items)	'I can easily switch between phases of high concentration and phases of relaxation'
Communication and cooperation (four items)	'When I am not feeling well, I have no problem accepting someone's help'

[a]Soellner *et al.* (Soellner *et al.*, 2017)

To verify the model structure in a first step and to examine the associations between the six constructs of the structural model of health literacy and work ability in a second step, SEM with partial least squares (PLS) was carried out with SmartPLS 2.0.M3 (Ringle *et al.*, 2005). PLS-SEM is able to incorporate reflective and formative indicators, is intended to explore relationships between latent constructs and provides path coefficients that are essentially standardized regression coefficients (Hair *et al.*, 2017).

The structural model (inner model) consists of one independent exogenous (latent) variable ('self-perception') and five dependent endogenous (latent) variables (Figure 1). According to previous studies, the 29 questionnaire items were aggregated to parcels (manifest variables) (Lenartz, 2012; Kuhlmann *et al.*, 2015) for forming the measurement (or outer) models for the reflective operationalizations of the latent variables (see Supplementary Digital Content). Mean value replacement was chosen as missing value algorithm.

Internal consistency reliability was assessed via Cronbach's α and composite reliability (CR), both compared to the 0.7 benchmarks (Hair *et al.*, 2017). Values between 0.6 and 0.7 are accepted in explorative studies (Hair *et al.*, 2017). To assess convergent validity, the average variance extracted (AVE) for each latent variable was compared to the 0.5 benchmark (Henseler *et al.*, 2009). Discriminant validity was assessed using cross-loadings of the parcels, which should be highest on the associated variable (Hair *et al.*, 2017), and the Fornell–Larcker criterion, which states that the square roots for each latent variable's AVE should be higher than its highest correlation with any other variable (Fornell and Larcker, 1981).

To further examine the associations between the structural model of health literacy and work ability, the WAI score was included as further endogenous variable and connected via paths with the four behavioural components of the model. Model's predictive power was evaluated with the coefficient of determination (R^2) for the five endogenous variables within the structural model and for work ability, with ≥0.02 indicating a small, ≥0.13 a median and ≥0.26 a large effect for the area of behavioural sciences (Cohen, 1988). The impact of the behavioural components on work ability were evaluated with effect sizes (f^2), with ≥0.02 indicating a small, ≥0.15 a median and ≥0.35 a large effect (Cohen, 1988). Bootstrapping process (495 cases, 5000 samples, Hair *et al.*, 2017) was used to estimate the significance of the paths with critical *t*-values of >1.960 ($p < 0.05$), >2.576 ($p < 0.01$) and >3.291 ($p < 0.001$) (Jahn, 2007; Hair *et al.*, 2017).

RESULTS

Sample and descriptive results

The participants had a mean age of 20.7 ± 1.9 years. More than half were female (59.0%). Mean BMI was 23.8 ± 4.4 kg/m^2. Health literacy scores varied between 2.6 and 3.0. Mean total WAI score was 39.7 ± 4.5, 48.9% were in the categories 'excellent'/'good', 51.1% in 'moderate'/'poor' (Table 2).

Measurement model

Cronbach's α for both self-perception and 'communication and cooperation' were below the benchmark, but CR for all variables was again above 0.7. Convergent validity was supported by AVE > 0.5 for each latent variable (Table 3). All parcels loaded on their respective variable higher than on any other, and square root of the AVE for each variable was higher than the

Table 2: Sample characteristics and descriptive results of health literacy and WAI ($n = 495$)

Characteristic outcome	Mean ± SD or %
Age (years)	20.7 ± 1.9
Sex (female)	59.0
BMI (kg/m^2)	23.8 ± 4.4
Health literacy (scores 1–4)	
Perceptive-motivational conditions	
Self-perception	3.0 ± 0.5
Proactive approach to health	2.6 ± 0.6
Behavioural components of health literacy	
Dealing with health information	2.8 ± 0.5
Self-control	2.8 ± 0.5
Self-regulation	2.7 ± 0.6
Communication and cooperation	2.6 ± 0.6
WAI score (range 7–49)	39.7 ± 4.5
Work ability categories[a]	
Excellent	12.6
Good	36.3
Moderate	32.8
Poor	18.3

Note. Valid percentages due to missing data.
[a]Following Kujala *et al.* (Kujala *et al.*, 2005).

Table 3: Internal consistency reliability and convergent validity in the measurement model

Latent variable	Cronbach's α	CR	AVE
Self-perception	0.67	0.85	0.74
Proactive approach to health	0.85	0.93	0.87
Dealing with health information	0.81	0.91	0.84
Self-control	0.76	0.89	0.80
Self-regulation	0.78	0.90	0.82
Communication and cooperation	0.69	0.86	0.76

correlations with all other constructs (Table 4), emphasizing discriminant validity.

Structural model

R^2 values were small to median with 24.8% of the variance of work ability explained (Figure 2). All β path coefficients within the structural model of health literacy were statistically significant ($p \leq 0.001$). Paths from 'self-control' ($\beta = 0.20$, $p < 0.001$, $f^2 = 0.04$), 'self-regulation' ($\beta = 0.31$, $p < 0.001$, $f^2 = 0.09$) and communication and cooperation ($\beta = 0.14$, $p < 0.001$, $f^2 = 0.02$) to work ability were significant, with all constructs having a small impact. The total indirect effects of self-perception ($\beta = 0.23$, $p < 0.001$, $t = 8.494$) and

Table 4: Cross-loadings and square root AVE in the measurement model (discriminant validity)

	Variable					
Parcel	**SP**	**PA**	**DI**	**SC**	**SR**	**CC**
SP-A	**0.917**	0.262	0.291	0.407	0.348	0.268
SP-B	**0.804**	0.137	0.224	0.289	0.216	0.181
PA-A	0.207	**0.945**	0.411	0.307	0.241	0.164
PA-B	0.249	**0.915**	0.328	0.186	0.182	0.196
DI-A	0.236	0.375	**0.912**	0.281	0.212	0.105
DI-B	0.318	0.363	**0.924**	0.278	0.181	0.041
SC-A	0.299	0.147	0.210	**0.846**	0.373	0.098
SC-B	0.420	0.308	0.316	**0.938**	0.372	0.082
SR-A	0.286	0.233	0.217	0.345	**0.893**	0.296
SR-B	0.324	0.188	0.172	0.400	**0.918**	0.312
CC-A	0.260	0.116	0.101	0.099	0.301	**0.907**
CC-B	0.200	0.235	0.027	0.069	0.286	**0.838**
Variable	**SP**	**PA**	**DI**	**SC**	**SR**	**CC**
SP	**0.86**					
PA	0.24	**0.93**				
DI	0.30	0.40	**0.92**			
SC	0.41	0.27	0.30	**0.89**		
SR	0.34	0.23	0.21	0.41	**0.91**	
CC	0.27	0.19	0.08	0.10	0.34	**0.87**

Note. 'self-perception' (SP), 'proactive approach to health' (PA), 'dealing with health information' (DI), 'self-control' (SC), 'self-regulation' (SR), 'communication and cooperation' (CC). In the lower half of the table, the bold numbers listed diagonally are the square root AVE of each variable.

'proactive approach to health' ($\beta = 0.05$, $p < 0.05$, $t = 2.533$) on work ability were statistically significant.

DISCUSSION

The main finding of the present study was that five out of six constructs of the structural model of health literacy showed a statistically significant indirect or direct effect, respectively, on work ability. The model explained 24.8% of the WAI score variance.

Health literacy scores and work ability

The scores for the six constructs of the structural model of health literacy varied between 2.6 and 3.0, which is in line with a previous study among grammar school pupils (mean age 18.1 ± 0.6 years, scores: 2.8–3.1) (Lenartz, 2012). The data underpin the necessity of interventions targeting young employees, as reduced work ability predicts long-term sickness absence in this target group (Kujala *et al.*, 2006). The sample is almost split in terms of good/excellent and poor/moderate work ability and the mean WAI score was 39.7 ± 4.5, which is

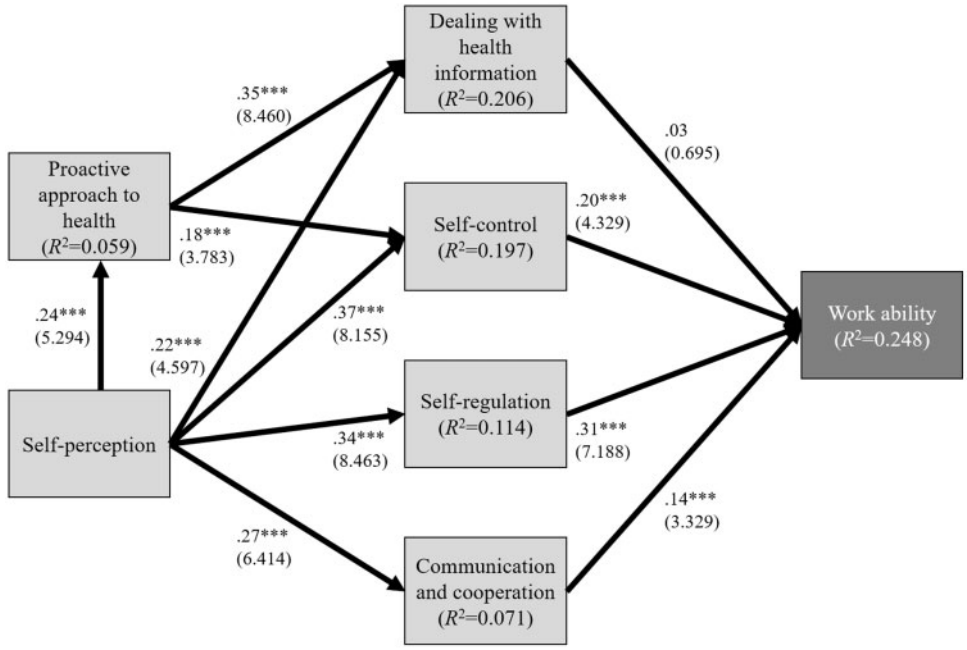

Fig. 2: Structural model of health literacy including work ability with R^2, β path coefficients and *t*-values.

comparable to a study among young Finnish employees on which basis the categories were reclassified (Kujala *et al.*, 2005).

Measurement and structural model

Cronbach's α and CR values were comparable to previous studies (Kuhlmann *et al.*, 2015; Soellner *et al.*, 2017). The discriminant validity results underline that the questionnaire is able to reflect the six advanced skills. The overall structure of the health literacy model could be verified for the target group of vocational school students, although some of the β path coefficients are lower than in previous studies (Kuhlmann *et al.*, 2015; Soellner *et al.*, 2017).

Associations between health-related skills and work ability

To our knowledge, this cross-sectional study is the first study to examine the relationships between the constructs of the structural health literacy model and the work ability in the target group of young employees.

Both self-control and self-regulation showed significant paths to work ability. Fiedler *et al.* already showed significant associations between these two constructs and subjective well-being among industry managers (Fiedler *et al.*, 2018). Furthermore, the role of self-control and self-regulation with regards to health (behaviours) among comparable target groups is already researched. Kuhlmann *et al.* found negative associations between the constructs self-control and self-regulation and the frequency of physical complaints among students (Kuhlmann *et al.*, 2015). Self-control is also associated with healthier food choices among young adults (Rising and Bol, 2017) and in adolescents, reduced self-control predicts higher BMI over the life course (Koike *et al.*, 2016) and health problems in early adulthood (Miller *et al.*, 2011). It was further shown that obese students have inferior values of self-regulation compared to normal-weight peers (Campos-Uscanga *et al.*, 2017). In general, self-regulation is associated with healthy nutrition and exercise (Shieh *et al.*, 2015). In addition, research indicates that recreational opportunities are associated with higher work ability in young employees (Boström *et al.*, 2016). Young workers' ability to self-regulate between phases of high workload and relaxation should therefore be supported.

Next, the construct communication and cooperation showed a statistically significant path to work ability. In a study with 1311 workers aged 21–25 years, Boström *et al.* found that an increased social support at work is strongly associated with an improved work ability (Boström *et al.*, 2012). Additionally, a good organizational climate and perceived support have a positive

influence on the well-being and work ability of employees (Tuomi *et al.*, 2004; Feldt *et al.*, 2009). Social relations help to cope with stress (Cohen, 2004), which is associated with physical complaints and reduced work ability (Oberlinner *et al.*, 2015). Social interaction and support should therefore be considered in health and work ability promotion by establishing communicative and co-operative health-promoting environments and actively incorporating young employees.

Additionally, proactive approach to health showed a statistically significant total indirect effect on work ability. Research shows that employees who are more active regarding managing their health have a better health status, a higher engagement in health-promoting measures and are also more satisfied with their jobs and show higher self-assessed work performance (Fowles *et al.*, 2009). Accordingly, especially young employees who are at the beginning of their careers should be strengthened in their ability to actively manage and to positively influence their health.

Finally, model's central construct self-perception also showed a statistically significant total indirect effect on work ability, which is comparable to other studies with different endogenous variables (Kuhlmann *et al.*, 2015; Fiedler *et al.*, 2018). Thus, self-perception appears to be a fundamental parameter for positively influencing work ability. By regulating the inner world of a person and simultaneously controlling external influences, these abilities lead to health-promoting behaviour and are of crucial importance (Lenartz, 2012).

The concepts of behavioural psychology within the structural model offer further facets in the modelling of health literacy at the individual level and complement existing focus on information-related and communicative competencies.

Strengths and limitations

With regards to the highly relevant target group of young adults, our sample of non-academics has an added value since most studies with young adults are conducted with students in university settings (Bonnie *et al.*, 2015; Oosterveen *et al.*, 2017). Age and BMI are comparable to German surveys and studies with vocational school students (Kaminski *et al.*, 2008; Mensink *et al.*, 2013). The higher number of female participants can be influenced by the sample, as commercial vocational training is more common in women (Statistisches Bundesamt, 2018).

The use of Lenartz's German questionnaire on health literacy makes it difficult to relate the results to other studies that used internationally established measurement tools like the HLS-EU-Q (Sørensen *et al.*, 2013) or the HLQ (Osborne *et al.*, 2013). The model used here mainly focuses on concepts of behavioural psychology (Lenartz, 2012) or classic health promotion behaviour model variables, respectively. Besides that, Lenartz's questionnaire does not provide an overall score. Selecting measurement tools in health literacy research remains difficult, as the concept of health literacy is understood, defined and operationalized differently and the progression of the understanding of health literacy led to an evolution regarding its measuring (Abel, 2008; Frisch *et al.*, 2012; McCormack *et al.*, 2013; Altin *et al.*, 2014; Haun *et al.*, 2014). In addition, in recent years, there has also been an increased focus on research into more specific literacies such as physical literacy, food or nutrition literacy and media or eHealth literacy (Levin-Zamir *et al.*, 2011; Edwards *et al.*, 2017; Griebel *et al.*, 2018; Truman *et al.*, 2020). Nevertheless, the structure of the model (Soellner *et al.*, 2017) and the questionnaire (Lenartz, 2012) offer the opportunity to highlight important skills. Translating and validating the questionnaire would allow international studies to be conducted. It should be examined to what extent this questionnaire could be used to evaluate health literacy interventions (Soellner *et al.*, 2017).

Of course, the cross-sectional data cannot elucidate a possible causality of the associations, although the assumption of an influence of health literacy on work ability seems reasonable due to the structure of the model (Soellner *et al.*, 2017). Further model verifications should be conducted (Kuhlmann *et al.*, 2015; Fiedler *et al.*, 2018) and the model should be further explored for different age and employee groups.

In the present study, a goodness-of-fit criterion was not applied, as the of use of PLS-SEM versus covariance-based SEM for confirmatory analyses is the subject of discussions (Tenenhaus *et al.*, 2004; Hair *et al.*, 2011; Henseler and Sarstedt, 2013). However, the general results of both approaches are comparable (Astrachan *et al.*, 2014; Amaro *et al.*, 2015). Besides, this study focused on presumed effect relationships. Finally, the item parcelling performed in the present study is partly viewed critically (Little *et al.*, 2002; Marsh *et al.*, 2013), but we have followed the approach of previous studies (Lenartz, 2012; Kuhlmann *et al.*, 2015).

CONCLUSIONS

The present study makes a contribution to the design of future interventions and measures aiming at increasing work ability of young employees. Due to the demographic change and the need of longer working lives, the

social importance of young employees for the labour market is unquestionable. Maintaining and promoting young employees' work ability becomes an important issue.

Therefore, the structural model of health literacy could be used for the differential development of interventions (Kuhlmann *et al.*, 2015). For young adults, institutions of (higher) education provide a very valuable environment for health promotion (Hagquist, 1997; St Leger, 2001) and are central to the promotion and strengthening of health literacy (Kickbusch, 2008; Nutbeam, 2008; Paakkari and Paakkari, 2012; Hurrelmann *et al.*, 2018).

Methodologically, the main challenges will be to develop and conduct longitudinal studies with strong designs (Brainard *et al.*, 2016; Visscher *et al.*, 2018). Based on this study, it will be necessary to investigate the extent to which target group-specific longitudinal health literacy interventions can be effective in both educational settings and at workplaces in order to sustainably increase the individual health-related skills and work ability of different young adult (employee) groups.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Health Promotion International* online.

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ETHICS APPROVAL

The Ethics Committee of the German Sport University Cologne has approved the study (reference: 118/2015).

DATA SHARING

The datasets analysed during the current study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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