Educational level as a predictor for anxiety and depression in ICD-patients.

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Abstract

Background

To combat sudden cardiac death, patients with life-threatening rhythm disorders receive implantable cardioverter defibrillators. However, implantation of this device carries psychosocial risks. This research focused on the predictive qualities of educational level on self-reported anxiety and depression in ICD patients 12 months after implantation, hypothesizing that higher educational levels resulted in lower levels of anxiety and depression.

Methods

The sample consisted of 231 patients *(mean age 66.5±10.5;20.3% female)*. Data was taken from a larger study that investigates patient perspectives on remote device monitoring. Self-report questionnaires, including the PHQ-9 and GAD-7, were used at multiple points in time to collect data. Student's T-tests and Chi-square tests were used to assess group differences between lower and higher education. Logistic regression analyses were employed to investigate the associations between educational level, anxiety and depression.

Results

Higher educated participants reported lower levels of depression compared to lower education *(p=.003)*. The logistic regression analyses performed showed no significant effect of educational level on reported anxiety, but did show a significant moderate effect of educational level on reported depression *(p=.002;OR =.20)*. A strong association between anxiety and depression was found as well *(p<.001;OR=22.81)*. No other significant associations were found.

Conclusion

Educational level is an important factor for predicting depression 12 months after ICD implantation, but not for predicting anxiety. A possible explanation is the result of educational level on socioeconomic status. Furthermore, it is important that psychoeducative information fits the educational level of the patient, since low satisfaction on information provision is related to depression.

Key words: Implantable cardioverter defibrillator, educational level, anxiety, depression.

Introduction

Cardiovascular diseases are the leading cause of death worldwide (Mendis, Puska & Norrving, 2011). According to an analysis of the Global Burden of Disease Study 2013 (2015), cardiovascular diseases accounted for 31.5% of deaths worldwide. About half of these deaths were the direct cause of sudden cardiac death, which in itself is a result of ventricular arrhythmias in 80% of cases (Mehra, 2007). While exact numbers vary, this could mean that an estimated 12% of people die of ventricular arrhythmias (as calculated from the numbers above).

The implantable cardioverter-defibrillator (ICD) and the cardiac resynchronization therapy-defibrillator (CRT-D) are designed to prevent sudden cardiac death. An ICD monitors the heart rate and checks for signs of arrhythmia. When the device senses ventricular fibrillation, it electrically discharges and releases a defibrillating shock. This resets hearth rhythm and prevents sudden cardiac death (Mirowski, Mower, Langer, Heilman & Schreibman, 1978). The CRT-D functions in the same way, but also carries a pacing function (Boston Scientific, 2007). The Multicenter Automatic Defibrillator Implantation Trial (MADIT), showed that patients treated with an ICD had a 54% lower risk of dying, compared to patients who received traditional treatment (Moss et al., 1996).

However, an ICD is not without its own share of problems. Next to physical discomfort from the device itself (Luderitz, Jung, Deister, Marneros & Manz, 1993), recipients of an ICD are also at risk of developing psychosocial distress. According to Godemann et al. (2004), patients who received an ICD report a lower Quality of Life (QoL) compared with the general population. QoL is a personal, multidimensional assessment of an individual's emotional, social and physical aspects as they are perceived (Centers for Disease Control and Prevention, n.d.). It was shown that ICD patients report significantly lower physical functional ability, emotional role function, physical- and general health perception than a comparative sample of randomly selected persons (Godemann et al., 2004). These differences have largely been attributed to increases in phobic anxiety and depression in patients with an ICD.

Earlier research by Sears, Fodaro, Lewis, Sotile and Conti (1999) suggests that 13-38% of ICD recipients report clinically relevant levels of anxiety. A systematic review by Magyar-Russell et al. (2011) however suggests rates between 11 and 26% when using validated diagnostic interviews instead of questionnaires. This is opposed to an estimated

4.1% prevalence rate in the general population (Löwe et al, 2008). While this is in line with other cardiac populations, research has indicated the existence of ICD-specific issues as well. Examples of these issues are fear of receiving a shock, fear for device malfunctioning, fear of death and fear of embarrassment, as argued in a study by Sears et al. (1999). In this study, the highest increase in anxiety was found in people who had already experienced multiple ICD shocks. This was due to the fear of receiving an electrical shock, a painful and unpleasant feeling (Sears et al, 1999).

Next to high anxiety rates, depression was found to be a prevalent problem in ICD patients as well (Bilge et al., 2006). Like in the study by Sears et al. (1999), there is a positive relationship between the number of shocks a patient has received and depressive symptoms. According to Bilge et al., the prevalence of depressive disorders in patients with an ICD is as high as 41%. However, Magyar-Russel et al. (2011) suggest that this prevalence rate is lower. According to them, it is in fact more in line with other cardiac populations at an assumed 20% prevalence rate. This is opposed to a prevalence rate in the general population which lies between 7.1% (Olsen, Mortensen, & Bech, 2004) and 9.5% (Hinz & Brahler, 2011).

Research has indicated several causes for this increase in anxiety and depression in patients with an ICD. Factors that influence anxiety and depression in ICD patients are gender, with women experiencing higher rates of anxiety and depression compared to men (Miller, Thylén & Moser, 2016); age, with younger ICD patients reporting higher levels of anxiety and depression compared to older patients (Thylén, Dekker, Jaarsma, Strömberg & Moser, 2014); and partner status, where living without a partner correlated with higher reported anxiety and depression. (Thylén et al., 2014). However, one possible predictor has not been extensively researched yet. The effect of educational level on anxiety and depression in a general population has been studied by Bjelland et al. (2008). Their research indicated that a higher educational level has a protective effect against both depression and anxiety, which accumulates over time.

This relationship between educational level and anxiety and depression has never been researched in ICD patients, however. Even though, there are reasons to assume that there is an effect of educational level within this population. One study conducted by Hoogwegt, Widdershoven, Theuns and Pedersen (2014), for instance, showed that a low satisfaction score of information provision was associated with an increase in anxiety and depression in ICD patients. It was speculated that educational level might relate to a better or

worse understanding of provided information. This might indicate at least an indirect effect of educational level on anxiety and depression within this population.This study will examine whether educational level is a predictor for self-reported anxiety and depression 12 months after ICD implantation. Two hypotheses are central to this article. The first hypothesis states that a higher educational level is associated with lower anxiety levels. The second hypothesis states that a higher educational level is associated with lower depression levels. Predetermined factors that influence anxiety and depression are gender, partner status and age. As such, these factors will be controlled for.

Method

Study design

Data from the REMOTE-CIED study by Versteeg et al., a multicenter prospective randomized controlled clinical trial, was used for the current study. This study focuses on 600 ICD-patients and the patients' perspective of remote patient monitoring versus in-clinic follow-ups.

Study population

The study conducted by Versteeg et al. (2014) screened for participants who have received an ICD or CRT-D at cooperating centers in France, Germany, Spain, Switzerland and the Netherlands. Patients who recently received a first-time (primary or secondary prophylactic) ICD or CRT-D compatible with the LATITUDE® Patient Management system from Boston Scientific, suffering from left ventricular ejection fraction (LVEF) ≤35% and symptomatic heart failure (New York Heart Association functional class II or III), and having provided written consent were eligible for study participation. Exclusion criteria were an age below 18 years or above 85 years, being on a waiting list for heart transplantation, having a history of psychiatric illness other than affective or anxiety disorders, or being unable to complete the questionnaires as a result of cognitive impairments or a language barrier. Follow-up data from this study by Versteeg et al. (2014) is still being collected. At this moment, 249 patients have completed 12 months follow-up questionnaires. Analyses in this current study are based on this subsample of REMOTE-CIED participants.

Procedure

Participants were contacted and given a baseline questionnaire (T0) during their hospital admission for ICD implantation. They were asked to complete this questionnaire and to return it within two weeks after implantation to Tilburg University. Patients were required to periodically fill in a set of questionnaires at later points in time (T1 = 3 months, T2 = 6 months, T3 = 12 months, T4 = 24 months post-implantation). The current study used data gathered at T0 and T3. After the baseline questionnaire was retrieved, participants were randomly divided over two groups. The first group consisted of patients who received the LATITUDE® Patient Management system 4 to 8 weeks after implantation. This group was remotely monitored and only visited the outpatient clinic 12 and 24 months after implantation. The second group received usual care, and visited the outpatient clinic every 3 to 6 months for a follow-up.

Measures

To measure sociodemographic variables, purpose-designed questions were introduced in the questionnaire. These questions measured gender, age, educational level, and partner status. Educational level was dichotomized into lower education (elementary education and secondary education) and higher education (vocational education and higher tertiary education). Partner status was dichotomized into having a partner (Married, partner living together and partner living apart) and not having a partner (single, divorced and widowed).

The Generalized Anxiety Disorder (GAD-7) was used to measure anxiety. This is a 7-item self-report questionnaire that measures symptoms of a generalized anxiety disorder. Scoring is done on a 4-point Likert scale ranging from 0-3, giving the participant 4 options to choose from: “not at all” (0), “several days” (1), “more than half the days”(2), and “nearly every day”(3). The GAD-7 has a total minimum score of 0 and maximum score of 21. The cut-off score for having a clinically relevant level of anxiety is 10. An example of an item from this scale is; “Becoming easily annoyed or irritable.” The GAD-7 was developed by Spitzer, Kroenke, Williams and Löwe (2006) and the scale is internally consistent (Cronbach’s $\alpha = .91$).

To measure depression, the Patient Health Questionnaire (PHQ-9) was used. This 9-item self-report questionnaire measures all 9 DSM-IV criteria of depression. Scoring is done

on a 4-point Likert scale ranging from 0-3, giving the participants 4 possible answers for every item: “not at all” (0), “several days” (1), “more than half the days”(2), and “nearly every day”(3). The PHQ-9 has a total minimum score of 0 and maximum score of 27. The cut-off score for having a clinically relevant level of depression is 10. An example item is “Thoughts that you would be better off dead or of hurting yourself in some way”. PHQ-9 was developed by Kroenke, Spitzer and Williams (2001) and has a Cronbach’s α of .83.

Statistical analysis

Sample characteristics were taken from T0 and T3, dichotomized where applicable and stratified for educational level. A descriptive analysis was then performed on this manipulated dataset. Student’s T-test (categorical variables) or a chi squared test (continuous variables), split by educational level, was used to check for significant differences between groups of higher and lower education. Tested variables were age, gender, partner status, self-reported anxiety and self-reported depression. Subsequently, two layered logistic regression analyses were then performed on the data. The first analysis was performed on anxiety with educational level as the only predictor. The second analysis focused on depression, with educational level as predictor. In this analysis, the covariates age, gender and partner status were introduced in the second step. The third step added self-reported anxiety as the final covariate. Statistical analysis of the data was done using SPSS 19.0 for Windows.

Results

Sample characteristics

In total, 249 ICD patients participated in this study. 92.8% (N = 231) delivered complete questionnaire data at baseline and 12 months after implantation. There were no significant differences in characteristics between the 231 with and 18 without full datasets. The mean age of the sample was 66.5±10.5 years and 20.3% was female. 15.6% of the patients reported clinically relevant levels of anxiety and 16.5% reported clinically relevant levels of depression. 45.5% of the patients had a low educational level (elementary and secondary education), and 54.5% were highly educated (vocational and higher tertiary education). 24.2% did not have a partner. The descriptive analysis indicated a significant

difference in self-reported depression between lower and higher educated groups, with higher depression rates in the former *(p = 0.03) (see table 1)*.

Hypothesized was that educational level serves as a predictor for self-reported anxiety and depression in patients with an ICD. The prediction was made that a higher level of education results in lower reported levels of anxiety and depression.

The association between educational level and anxiety at T3

To predict clinically relevant levels of anxiety based on the cut-off score for the GAD-7 by educational level, a logistic regression analysis was performed *(table 2)*. Pseudo R^2-values indicate that between .4 and .7 percent of the variability was explained by this model. No significant relation was found between educational level and anxiety *(p = .34, OR = .71, 90% CI OR [.38, 1.25])*.

The association between educational level and depression at T3

Secondly, to predict clinically relevant levels of depression based on the cut-off score for the PHQ-9 by educational level, a 3-step logistic regression analysis was performed *(table 3)*. In the first step, only educational level was added as a predictor. This model reliably distinguished between self-reported levels of depression based on the cut-off score *(chi square = 9.75, p = .002, df = 1)*. This model explained 4.1 to 7% of the variance in depression. A significant relationship between educational level and self-reported levels of clinical depression was found *(p = .003, OR = .32, 90% CI OR [.17, .60])*. This implies that the odds ratio to report clinical levels of depression for higher educated participants were .32 times that of participants with a lower educational level.

In the second step, the covariates gender, age and partner status were added to the model. This model reliably distinguished between self-reported depression as well, building upon the previous model *(chi square = 20.21, p < 0.001, df = 4)*. As indicated by the pseudo R^2-values, 8.4 to 14.2% of the total variance in depression was explained by this model. In this model, both educational level *(p = .001, OR = .26, 90% CI OR [.14, .53])* and age *(p = 0.04, OR = .96, 90% CI OR [.94, .99])* were significant predictors for depression. The score for age implies that the odds ratio of reporting levels of clinical depression is .96 per increase

of age in years. Patients with a higher educational level were .26 times as likely to report a clinically relevant level of depression, controlling for all other factors in this model. Likewise, the odds ratio of age signifies that for every additional year patients are .96 times as likely to report depression, controlling for all other factors in this model.

The third step added self-reported levels of clinical anxiety based on the GAD-7 cut-off score to the model. This model again built upon the previous model with an increased chi square and reliably distinguished between self-reported depression or not *(chi square = 68.46, $p < 0.001$, $df = 5$)*. Pseudo R^2-values showed that 25.6 to 43.4% of the total variance in depression could be explained by this model. This third model showed that both educational level *($p = .002$, OR = .20, 90% CI OR [.09, .47])* and anxiety *($p < .001$, OR = 22.81, 90% CI OR [10.20, 51.02])* were significant predictors of self-reported depression. The odds ratio of participants with a higher level of education to report depression lowered by adding this final covariate. Patients with a higher educational level were .20 times as likely to report depression when compared to patients with a lower level of education, controlling for all other factors in the model. Patients who reported clinically significant levels of anxiety, meanwhile, were 22.8 times more likely to also report clinical levels of depression, controlling for other factors in the model.

Discussion

Main findings

The present study investigated the relationship between educational level and anxiety and depression in ICD patients. A significant, but moderate, effect of educational level on depression was found. This effect indicates that a higher education level results in lower depression levels. There was no significant relationship between educational level and anxiety. A strong effect was found between self-reported anxiety and depression, however, wherein a higher levels of anxiety was associated with a higher levels of depression. Lastly, a small but significant effect of age was also found to influence reported levels of depression. These levels decreased as age increased. However, this effect disappeared after adding anxiety as a covariate.

A possible explanation might be the differences in information processing between lower and higher educated patients. Hoogwegt et al. (2014) researched the effects of

satisfaction with information provision. They found that lower satisfaction levels are associated with higher rates of depression and anxiety. However, when assumed that information is equally provided for everyone, the individual understanding of this information might be an important factor in the satisfaction with information provision. Therefore it is arguable that people with a higher educational level benefit more from information provision and psychosocial interventions like psychoeducation. A possible explanation lies in the ability to process the provided information. It is expected that people with a higher educational level process this better.

Another possible explanation for the results is the strong relationship between educational level and socioeconomic status (SES). This is because SES is measured as a combination of education, income and occupation (American Psychological Association, n.d.). Level of education influences income and professional situation as well (Yan, 2014). Meanwhile, SES has been related to self-reported clinical levels of anxiety and depression (Everson, Lynch & Kaplan, 2002; Lorant, 2003). A lower SES was associated with higher levels of anxiety and depression. This makes it possible for educational level to indirectly be responsible on rates of depression through SES.

Comparisons with other studies

Educational level influencing (self-reported) rates of depression has been reported in other studies as well, for example in the aforementioned study by Bjelland et al (2008). Wang, Schmitz and Dewa (2009) found similar results in their study as well. Both studies found a decline in reported depression when educational level went up, as was found in this study. Both of these studies also found a strong correlation between anxiety and depression. However, both of these studies also indicated a relationship between educational level and anxiety. This relationship was not present in the current study. These results might indicate that educational level has a different effect on anxiety in ICD patients, than in a general population. One conceivable explanation for this lies in the cause of anxiety. If a person is healthy yet anxious about their health, showing them that they are healthy may help with their anxiety. Results like these have been found in treating hypochondriasis through psychoeducative means (Bouman, 2002; Buwalda, Bouman & Duijn, 2007). Educational level may help them in understanding this better, thereby becoming a mitigating factor. However, when a person is actually ill, this same strategy of showing them they are actually

healthy cannot be applied. Therefore educational level may not be as much of a factor within sick individuals.

Although age, gender and partner status were expected covariates based on earlier research, they held no significance in the present study. These findings conflict with a number of studies. Miller, Thylén & Moser (2016) suggest that gender has significant influence on self-reported anxiety and depression within a population of ICD patients, with women reporting higher rates in both. Earlier research by Jorm (2000) and Henderson et al. (1998) has indicated that a significant effect of age on both anxiety and depression exists in the general population. Self-reported rates of anxiety and depression seem to decrease with age. Thylén et al. (2014) researched this and found similar results within the ICD patient population. They also found significant differences between having a partner or not, with patients who had a partner reporting lower rates of both anxiety and depression. Why similarly significant results on these variables are not reproduced within the current study is unclear. An explanation for these differences might be the usage of different variables and questionnaires to collect the present data. This current study was conducted mainly on data from one year after implantation, which is later than other studies mentioned here. The possibility exists that a certain degree of recovery sets in during the first year after implantation. This could alter reported anxiety and depression rates.

Strengths and limitations

Strengths of this study include a large and multinational study sample, providing sufficient statistical power. The study design was a randomized controlled clinical trial, which is currently a high standard for research (Simon, 2001). Data has been gathered over 5 different countries (France, Germany, Spain, Switzerland and the Netherlands), which gives us more generalizable results. This is because collected data is not bound to a single country. Furthermore, the instruments that were used in data collection are well validated (Kroenke et al., 2001; Spritzer et al., 2006) and were properly adapted between languages. Lastly, this research provides a base for further research on educational level.

A limitation of this study lies in the way that self-reported anxiety and depression were dichotomized by a set cut-off score. This means that some information on effect size could be lost (MacCallum, Zhang, Preacher, & Rucker, 2002). Nevertheless, the cut-off scores used in this research were set by the original questionnaire creators for each respective

questionnaire. They are thoroughly tested, so a certain degree of validity can be assumed. Furthermore, self-report data is always accompanied with biases, like social desirability bias and central tendency bias (Choi & Pak, 2005). Social desirability compels people to answer what they think other people want them to answer, thereby sacrificing their own opinion. Central tendency on its turn makes respondents avoid the ends of a scale, where they might underrepresent the strength of their opinion. These biases can skew the collected data, since the respondents may not answer truthfully.

Another limitation might be the way in which educational level was classified and dichotomized. Level of education was measured by highest level completed, and then dichotomized into comparable group sizes. Other research however has looked at total number of educational years or dichotomized it at a lower point. This lower cut-off score often lies below secondary education. Both of those methods might give a different image. However, dichotomizing at a lower educational level might be insufficient for current research. The current generation of the general population has had access to better education and is higher educated in general (Eurostat, 2016). Assuming a cut-off before secondary education can lead to unequal group sizes in that case. It can be argued, therefore, that setting the cut-off score lower is an outdated concept. In this research, there was a good balance between participants on educational level, however, with comparably-sized groups. A final limitation might be the lack of available clinical data. Because of this, it is impossible to determine a difference in level of sickness between groups in this study. Differences in sickness could influence anxiety and depression, however.

Implications

The most important implication of this study is that educational level should not simply be taken into account as yet another covariate, but could be researched as a topic of research on its own. Research could look at the difference in anxiety between ill and healthy individuals, and the influence of education on both. In addition, educational level should be considered important for research on depression and especially so in ICD patients. The effects of it in other at-risk populations, such as cancer patients, could also be studied further.

Furthermore, future research could look at how illness perception affects patients with ICD and the influence of educational level on understanding information provision and psychological interventions such as psychoeducation. If a connection exists, psychoeducative

methods could be adapted for different educational levels. Information could be delivered in a way that enables the patient to understand it. For example, by spending more time explaining information for patients who need it, and less time for more eager patients. Doctors or psychologists could take this into account before symptoms of clinical anxiety and depression surface. This might help to decrease anxiety and depression amongst ICD patients.

Conclusion

A higher educational level does indeed result in lower levels of depression, as hypothesized. This means that taking educational level into consideration when treating ICD patients might be beneficial, for instance by adjusting psychoeducation to the correct level. However, there does not seem to be any predictive value in educational level when looking at anxiety levels. Further research on the subject is needed to obtain a better image of the effects of educational level.

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Tables

Table 1: *Patient characteristics stratified for low and high education .*

	Total sample (N=231)	*Low education (N=105)*	*High education (N=126)*	*p-value*
Age	66.5 ± 10.5	67.2 ± 8.8	65.79 ± 11.8	.41
Female	47 (20.3%)	24(22.9%)	23(18.3%)	.39
Having a partner	175(75.8%)	80(76.2%)	95(75.4%)	.89
Anxiety	36(15.6%)	19(18.1%)	17(13.5%)	.34
Depression	38(16.5%)	26(24.8%)	12(9.5%)	.003*

*Continuous variables are displayed as mean +/- sd and categorical variables as N(%). Data was taken from 12 months after implantation. Anxiety is scored as present if GAD-7 score is ≥ 10 and depression is scored as present if PHQ-9 score is ≥ 10. p-values of continuous variables are calculated with Student's T-tests and categorical variables with Chi-squared tests. * = $p < .05$*

Table 2: *Logistic regression table for self-reported clinical levels of anxiety with educational level as predictor (N = 231).*

Predictor	ß	Wald's χ^2	*p*	Odds Ratio	90% CI Odds Ratio
Higher education	.35	.54	.46	1.42	[.39, 1.28]

Table 3: *Logistic regression table for self-reported levels of clinical depression with educational level (step 1), gender, age, having a partner (step 2) and self-reported clinical levels of depression (step 3) as predictors (N = 231).*

Predictor	ß	Wald's χ^2	*p*	Odds Ratio	90% CI Odds Ratio
Step 1					
Higher education	-1.14	9.07	.003*	.32	[.17, .60]
Step 2					
Higher education	-1.29	10.41	.001*	.28	[.14, .53]
Female	.36	.69	.41	1.42	[.708, 2.87]
Age in years	-.04	4.12	.042*	.96	[.936, .99]
Having a partner	-.77	3.67	.06	.46	[.24, .90]
Step 3					
Higher education	-1.59	9.92	.002*	.20	[.09, .47]
Female	-.02	.001	.98	.99	[.41, 2.37]
Age in years	-.03	1.90	.17	.97	[.94, 1.01]
Having a partner	-.77	2.54	.11	.46	[.21, 1.03]
Reported anxiety	3.13	40.86	<.001*	22.81	[10.20, 51.02]

** = p<.05*