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ORIGINAL ARTICLE

Differentiated thyroid cancer: effect on quality of life, depression, and anxiety

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Abstract

Context Thyroid cancer is the most common endocrine cancer, the lifelong risk for which is approximately 1%. Despite favorable prognosis and well-tolerated treatment modalities, numerous studies have shown that thyroid cancer survivors have impaired health-related quality of life (HRQoL). Patients are also more frequently affected by depression and anxiety.

Objective We aimed to evaluate HRQoL, depression, and anxiety status in female patients with DTC.

Design, subjects, and methods We compared HRQoL, depression, and anxiety status in 114 female thyroid cancer survivors with 110 healthy subjects via a cross-sectional design. For this purpose, we utilized short-form 36 (SF-36), Beck Depression Inventory (BDI), and Beck Anxiety Inventory (BAI).

Results The majority of the patients (82%) were stage I. Fifty-seven patients (51%) received radioiodine treatment. Regarding HRQoL, depression, and anxiety between groups, thyroid cancer survivors did worse on every aspect of SF-36 than the control group ($p < 0.05$). Thyroid cancer survivors had higher BDI and BAI scores ($p < 0.05$). In those receiving RAI, the dose of RAI, lymph node dissection, and tumor stage did not affect SF-36, depression, and anxiety scores. Duration since diagnosis also did not affect results.

Conclusion Our study further confirms the observation that survivors of DTC have impaired HRQoL. Furthermore, they are more likely to suffer from anxiety and depression.

Keywords Thyroid cancer · Quality of life · Depression · Anxiety

Introduction

Thyroid cancer is the most common endocrine cancer, regardless of ethnicity. The most common subtypes are papillary and follicular cancers, which are known as differentiated thyroid cancers (DTCs). Lifelong risk for thyroid cancer is approximately 1% [1]. Over the past few years, the incidence of DTC has been rising more than that of any other malignancy [2]. Although this fact was previously attributed to the detection of microcarcinomas by routine ultrasonography, a study by the American National Cancer Institute clearly demonstrated that tumors > 4 cm are also on the rise [1, 2]. Treatment of DTC includes surgery, radioactive iodine (RAI), and levothyroxine suppression. Patients usually tolerate these treatments with no or mild side effects. The 5-year survival rates for DTC are about 95%, and 20-year survival rates are 80–90%. However, due to recurrence rates (8–28%), lifelong surveillance is necessary. It is projected that, given the increasing frequency and excellent prognosis of DTC, the number of thyroid cancer survivors will inevitably increase. Despite a favorable prognosis and well-tolerated treatment modalities, several studies have shown impaired health-related quality of life (HRQoL) among most thyroid cancer survivors [3]. These patients were also more frequently affected by depression and anxiety [4]. To our knowledge, no study from Turkey has to date addressed these issues. For this reason, we aimed

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to evaluate HRQoL, depression, and anxiety status in female patients with DTC in this cross-sectional study.

Material and methods

DTC survivors

This study was conducted in female patients who applied to our clinic over a period of 6 months. Survivors of DTC followed up in our department were invited to participate. The design was cross-sectional. The exclusion criteria were as follows:

a) Male subjects
b) Age < 18 or > 65
c) Pregnancy or lactation
d) History of other malignancies
e) Diagnosis of psychiatric disorders
f) Use of antidepressants or anxiolytics for any cause
g) RAI treatment within the past 6 months
h) Patients who did not wish to participate

We excluded male subjects based on the fact that fewer than 10% of our DTC survivors were male. For this reason, the study population was composed only of female patients.

Controls

Controls were selected from healthy subjects without a history of thyroid disease and cancer. The same exclusion criteria were used.

Participants

After exclusion, 114 patients with DTC and 101 controls remained. All participants signed consent forms.

Medical data

Demographic data of survivors, comorbidities, levothyroxine dose, thyroid function tests, and tumor characteristics (tumor node metastasis classification, histopathology, and age at diagnosis), treatment (surgical complications and cumulative 131-I dose), and follow-up (follow-up time; outcome and level of TSH suppression during follow-up) were retrieved from the medical records. No patients suffered from permanent hypoparathyroidism or recurrent laryngeal nerve damage.

HRQoL assessment

We surveyed the DTC survivors and controls using HRQoL, depression, and anxiety questionnaires. The questionnaires are delineated below.

Short-Form 36

Short-Form 36 (SF-36) is a 36-item health survey developed by Hays et al. and validated for the Turkish population [5, 6]. The form evaluates HRQoL in eight domains, as follows: physical functioning, role limitations due to physical problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional issues, and mental health. The scores of the domains are presented on a scale from 0 to 100. A higher score indicates better HRQoL. However, this survey does not cover clinical depression and anxiety. Therefore, we employed specific depression and anxiety questionnaires to evaluate emotional well-being.

Beck depression inventory

Different questionnaires are available for the evaluation of depressive mood. In 1961, Beck et al. developed the Beck Depression Inventory (BDI) [7]. This self-reported inventory consists of 21 questions. Each question has 0–3 points. Higher scores imply clinically relevant to severe depression. BDI cutoff scores to be used with affective disorder patients are as follows: scores 0–9 indicate no or minimal depression; scores 10–18 indicate mild to moderate depression; scores 19–29 indicate moderate to severe depression; and scores 30–63 indicate severe depression. We chose to use the current BDI, which has Turkish validation.

Beck anxiety inventory

We evaluated our patients' anxiety levels with the Beck Anxiety Inventory (BAI) [8]. This self-reported inventory consists of 21 questions. Each question has 0–3 points. Therefore, higher scores imply increasing anxiety levels. Scores are classified as minimal anxiety (0–7), mild anxiety (8–15), moderate anxiety (16–25), and severe anxiety (30–63). The inventory is a counterpart of BDI for anxiety and is valid for the Turkish population [9].

Statistical analysis

Continuous variables were expressed as mean, standard deviations (SD), median, and minimum-maximum values, according to the provided condition of parametric or nonparametric distribution, and categorical variables as frequency and/or percentage. The normal distribution pattern was tested with the Kolmogorov–Smirnov test. The

chi-square (X^2), independent samples *t* test, and Mann–Whitney *U* test determined differences between groups when appropriate. Categorical variables were compared with an r^2 test. Correlation analyses between continuous variables were performed using Spearman or Pearson correlation analysis, depending on the distribution pattern. A 2-tailed p value < 0.05 was considered statistically significant. All statistical analyses were performed using the Statistical Package for Social Science (SPSS, Chicago, IL, USA) for personal computers, version 20.0 (SPSS).

The ethical committee of Gazi University Faculty of Medicine, Ankara, Turkey, approved this study.

Results

Demographics

One hundred and fourteen patients with DTC were compared with 101 healthy subjects. All participants were female. The survivor group was older than the controls (49.5 (20–64) vs. 41.0 (23–65)) ($p = 0.002$). Groups were similar in terms of total comorbidities or diabetes, hypertension, and coronary artery disease alone ($p = 0.854$). Never smokers were equal for both groups. There were more ex-smokers in the survivor group compared to the control group (10% vs. 1%) ($p = 0.024$). Data are summarized in Table 1.

Thyroid cancer survivors

The median L-thyroxine dose was 125 (50–250) mcg/day. Mean survival was 4.66 ± 3.04 years. One hundred and two patients (92%) underwent total thyroidectomy and nine patients (8%) underwent subtotal or hemithyroidectomy. Only nine patients (8%) had lymph node dissection. Fifty-seven patients (50%) received RAI treatment. The total RAI dose was 100 (80–600) mCi. The majority of the patients (85%) were stage I. Median TSH was 0.25 (0.005–97.7) nIU/mL. Median sT3 was 2.84 (1.8–5.15) ng/L, and median sT4 was 1.57 (1.06–2.61) ng/dL. Data are presented in Table 2.

Table 1 Demographics

	Thyroid cancer survivors (*n*:114)	Controls (*n*:101)	*p* p değeri
Age	49.5 (20–61)	41.0 (23–65)	0.002
Comorbidity (any)	41.0 (35%)	35.0 (34%)	0.854
Diabetes mellitus	18.0 (16%)	14.0 (14%)	0.706
Hypertension	28.0 (24%)	27.0 (26%)	0.756
Coronary artery disease	3.0 (2%)	6.0 (5%)	0.311
Smoking			0.026
-active smoker	18.0 (16%)	25.0 (24%)	0.024
-never smoker	79.0 (73%)	74.0 (73%)	0,997
-ex-smoker	11.0 (10%)	2.0 (1%)	0.024

HRQoL, depression, and anxiety among groups

Thyroid cancer survivors did worse on every aspect of the SF-36 than the control group, with the difference being significant. The physical functioning score for the thyroid cancer group was 24 (10–30); for the control group, it was 28.00 (13–30) ($p < 0.001$). The role limitations due to physical problems score for the thyroid cancer group was 6.50 (4–8); for the control group, it was 7.00 (4–8), ($p < 0.001$). The bodily pain score for the thyroid cancer group was 8.20 (2–12); for the control group, it was 10.40 (2–12) ($p < 0.001$). The general health score for the thyroid cancer group was 16.00 (5–24); for the control group, it was 21.40 (9–25) ($p < 0.001$). The vitality score for the thyroid cancer group was 14.00 (6–24); for the control group, it was 20.00 (7–23) ($p < 0.01$). The social functioning score for the thyroid cancer group was 7.00 (3–10); for the control group, it was 8.00 (4–10) ($p < 0.001$). The role limitations due to emotional problems score for the thyroid cancer group was 5.00 (3–6); for the control group, it was 6.00 (3–6), ($p < 0.01$). The mental health score for the thyroid cancer group was 20.00 (10–30); for the control group, it was 26.00 (11–30) ($p < 0.001$). Data are presented in Table 3.

Thyroid cancer survivors' BDI and BAI scores were also higher than those of the control group, which was statistically significant. The BDI score for thyroid cancer survivors was 8.0 (0–34.0), which was consistent with minimal

Table 2 Thyroid cancer survivors

L-thyroxine dose (mcg/day)	125.0 (50–250)
Survival in years (min–max)	4.66 ± 3.04 (1–23)
Surgery	
Total thyroidectomy	102 (91%)
Other thyroidectomies	9 (8%)
Lymph node dissection	9 (8%)
RAI treatment	57 (50%)
RAI total dose (mCi) (min-max)	100.00 (80–600)
Stage	
I	95 (%83)
II	7 (%6)
III	5 (%5)
IV	7 (%6)
TSH(mIU/L) (min–max)	0.25 (0.005–53.6)
sT3 (ng/L) (min–max)	2.84 (1.84–5.15)
sT4 (ng/dL) (min–max)	1.57 (1.06–2.61)

Normally distributed continuous variables are presented as mean ± SD, while non-normal variables are presented as median (min–max)

Table 3 HRQoL, depression, and anxiety among groups

SF-36	Thyroid cancer survivors	Controls	*p*
Physical functioning	24.00 (10-30)	28.00 (13-30)	<0.001
Role limitations due to physical problems	6.50 (4-8)	7.00 (4-8)	0.008
Bodily pain	8.20 (2-12)	10.40 (2-12)	<0.001
General health	16.00 (5-24)	21.40 (9-25)	<0.001
Vitality	14.00 (6-24)	20.00 (7-23)	<0.001
Social functioning	7.00 (3-10)	8.00 (4-10)	<0.001
Role limitations due to emotional problems	5.00 (3-6)	6.00 (3-6)	<0.001
Mental health	20.00 (10-30)	26.00 (11-30)	<0.001
Beck Depression Score	8.00 (0-34)	3.00 (0-25)	<0.001
Beck Anxiety Score	12.00 (0-55)	4.00 (0-33)	<0.001

Normally distributed continuous variables are presented as mean ± SD, while non-normal variables are presented as median (min–max)

depression, and that of the control group was 3.0 (0–25.0) ($p < 0.001$). The BAI score was 12.0 (0–55.0), compatible with mild anxiety, and that of the control group was 4.0 (0–33.0), ($p < 0.001$). Data are presented in Table 3.

Comparison of thyroid cancer survivors with regard to age

Among the 114 thyroid cancer survivors, mean age was 46. Patients were grouped as younger than 46 years of age or older. The SF-36 (every domain), depression, and anxiety scores were not different between younger and older patients ($p > 0.05$). Detailed results are shown in Table 4.

Comparison of thyroid cancer survivors with regard to cancer stage

Among the 114 thyroid cancer survivors, 95 (83%) had stage 1 disease. The rest had stage 2–3 or 4 disease ($n = 19$, 17%). The SF-36 (every domain except for general health), depression, and anxiety scores were not different between early-stage and late-stage disease. ($p > 0.05$) (Detailed p values are displayed in Table 5). Late-stage patients had worse scores in the "general health" aspect of the SF-36 questionnaire ($p = 0.010$).

Comparison of thyroid cancer survivors with regard to RAI treatment

Among the 114 thyroid cancer survivors, 57 received (50%) RAI treatment. The SF-36 (every domain), depression, and anxiety scores were not different between RAI receivers and non-receivers ($p > 0.05$) (Detailed p values are displayed in Table 6). The dose of RAI (150 mci vs. lower), lymph node dissection, and stage of cancer also did not affect the SF-36, depression, and anxiety scores (data not shown).

Table 4 HRQoL, depression, and anxiety among patients with regard to age

SF-36	Age ≤ 45 *n* = 44	Age ≥ 46 *n*: 77	*p*
Physical functioning	24.23 (12–30)	22.37(10–30)	0.052
Role limitations due to physical problems	6.82 (4–8)	6.79 (4–8)	0.061
Bodily pain	8.77 (2–12)	8.04 (2–12)	0.147
General health	16.37 (8–25)	15.66 (5–24)	0.400
Vitality	15.00 (6–24)	14.03 (6–24)	0.260
Social functioning	7.57 (4–10)	7.04 (3–10)	0.150
Role limitations due to emotional problems	4.93 (3–6)	4.51 (3–6)	0.064
Mental health	20.86 (11–30)	19.89 (10–30)	0.056
Beck Depression Score	10.41 (0–32)	12.26 (0–34)	0.076
Beck Anxiety Score	14.25 (0–44)	16.36 (0–55)	0.377

Normally distributed continuous variables are presented as mean ± SD, while non-normal variables are presented as median (min–max)

Table 5 HRQoL, depression, and anxiety among patients with stage 1 vs. stages 2–4 thyroid cancer

SF-36	Stage 1 *n* = 95	-Stages 2–4 *n*: 19	*p*
Physical functioning	22.8 (10–30)	23.5 (10–30)	0.491
Role limitations due to physical problems	6.5 (4–8)	6.7 (4–8)	0.730
Bodily pain	8.1 (2–12)	8.9 (2–12)	0.160
General health	15.2 (5–24)	18.2 (9–25)	0.010
Vitality	14.1 (6–24)	14.1 (6–23)	0.611
Social functioning	7.00 (3–10)	7.7 (3–10)	0.192
Role limitations due to emotional problems	4.6 (3–6)	4.9 (3–6)	0.248
Mental health	19.4 (10–30)	20.0 (10–30)	0.598
Beck Depression Score	12.05 (0–34)	8.7 (0–28)	0.077
Beck Anxiety Score	16.50 (0–55)	11.2 (0–33)	0.103

Normally distributed continuous variables are presented as mean ± SD, while non-normal variables are presented as median (min–max)

Table 6 Comparison of thyroid cancer survivors with regard to RAI treatment

SF-36	RAI group *n*: 72 (63%) almış (*n* = 75)	NO RAI group *N*: 42 (37%) almamış (*n* = 39)	*p*
Physical functioning	23.5 (10–30)	25.0 (12–30)	0.222
Role limitations due to physical problems	6.0 (4–8)	7.0 (4–8)	0.292
Bodily pain	8.2 (2–12)	8.4 (4.2–12)	0.586
General health	15.4 (5–24.4)	16.0 (8–23.40)	0.861
Vitality	14.0 (6–24)	15.0 (7–24)	0.774
Social functioning	7.0 (3–10)	8.0 (4–10)	0.387
Role limitations due to emotional problems	5.0 (3–6)	5.0 (3–6)	0.169
Mental health	19.0 (10–30)	21.0 (11–30)	0.810
Beck Depression Score	11.0 (0–32)	8.0 (1–34)	0.384
Beck Anxiety Score	13.0 (0–55)	10.0 (0–52)	0.417

Normally distributed continuous variables are presented as mean ± SD, while non-normal variables are presented as median (min–max)

Comparison of thyroid cancer survivors with regard to years after diagnosis

The patients were assigned to two groups, those with a diagnosis duration of less than 2 years ($n = 28$), and those with more than 2 years ($n = 86$). When the two groups were compared, no significant differences were observed in SF-36, depression, and anxiety scores ($p > 0.05$).

Comparison of thyroid cancer survivors with regard to serum TSH levels

Twenty-five patients were not at target TSH levels, having above TSH > 2 mIU/L due either to drug non-compliance or to withdrawal for RAI. The patients were grouped according to serum TSH levels, and the TSH < 0.1 mIU/L, 0.1–0.5 mIU/L, 0.5–2 mIU/L, 2–10, and > 10 mIU/L groups consisted of 41, 24, 24, 17, and eight patients, respectively.

Patients with TSH > 10 mIU/L, when compared to those with TSH < 0.1 mIU/L, did worse on the "pain" and "general health" aspects of SF-36 and had worse BAI scores. The same group, when compared to those with TSH = 2–10, did worse on the "role limitations due to physical problems" aspect of SF-36 and had worse BAI scores.

Other comparisons revealed no significant differences in either the SF-36 scale or on BDI or BAI scores. Data are presented in Table 7.

Discussion

In this study, we found that DTC survivors had impaired HRQoL compared to healthy controls. Thyroid cancer is the most common endocrine cancer [1]. DTC usually has an excellent prognosis, with 20-year survival rates approaching 80–90% [10, 11]. However, surgical and medical morbidity may have an impact on survivors. Local

Table 7 Comparison of groups with regard to TSH levels

Domain/TSH level	< 0.1 ($n=41$)	0.1–0.5 ($n=24$)	0.5–2 ($n=24$)	2–10 ($n=17$)	> 10 ($n=7$)	p value
Physical functioning	23.76	22.63	22.50	24.53	19.75	1
Role limitations due to physical problems	6.56	5.96	6.13	7.06	5.13	*
Bodily pain	9.05	8.21	8.05	8.13	6.16	**
General health	16.43	15.96	15.89	16.80	11.65	***
Vitality	14.34	14.79	14.92	14.82	11.13	1
Social functioning	7.34	7.42	6.96	7.88	5.75	1
Role limitations due to emotional problems	4.66	4.75	4.71	4.94	3.88	1
Mental health	19.68	19.46	19.75	20.53	17.63	1
Beck Depression Score	11.49	10.00	12.17	8.06	16.50	1
Beck Anxiety Score	14.34	15.29	15.38	13.06	28.25	****

Pairwise comparison, with Bonferroni's correction

1 No significant differences between any of the groups

* 2–10 vs. > 10. $p=0.034$

** < 0.1 vs. > 10 $p=0.037$

*** < 0.1 vs. > 10 $p=0.046$

**** < 0.1 vs. > 10 $p=0.035$

2–10 vs. > 10 $p=0.039$

recurrence can present even years after treatment, necessitating lifelong surveillance [12]. All these problems may contribute to lower HRQoL in thyroid cancer survivors.

Every type of cancer negatively affects HRQoL. It was previously thought that due to its excellent prognosis, thyroid cancer would not have such a detrimental effect, and a 2008 study from Helsinki University with 341 patients supported this theory. Patients were evaluated with D15 (an HRQoL inventory), and the result was comparable to that of a healthy population [13]. However, in contrast, Lee et al. from Korea demonstrated that the HRQoL of thyroid cancer survivors was markedly decreased compared to that of healthy controls. In the latter study, the Hospital Anxiety and Depression Scale (HADS) together with the Brief Fatigue Inventory was used [14]. Another survey from Holland reported high depression scores for thyroid cancer survivors that lasted up to 12 years and began to decline and reach the normal values of the population after about 20 years [15]. Finally, a review by Husson et al. surveyed 27 studies and concluded that thyroid cancer survivors have a lower quality of life and higher depression scores compared to the general population [3].

Our thyroid cancer survivors were older than the controls, but the mean ages of both groups were in the fourth decade. Studies on age and depression showed that prevalence of depression increased in adolescents and the elderly [16, 17]. Since neither of our groups belonged to the latter age groups, we do not consider that the age difference between the two groups greatly affected our results. Furthermore, age did not dominate the intergroup comparison of survivors (Table 4). We therefore conducted this analysis based on the fact that the study groups' mean and median age was 46.

Another difference between the two groups was the number of ex-smokers. For example, 10% of thyroid cancer survivors were ex-smokers. It is a known fact that people with a diagnosis of cancer are often more motivated to quit smoking [18]. Another explanation for the lower smoking rates in the cancer survivor group may be more frequent visits to the hospital to obtain health risk appraisal in order to stop smoking, as well as more doctors recommending that patients quit smoking [19].

Our results indicate that time since diagnosis does not affect SF-36 or BDI and BAI scores. On the contrary, a study from Austria on 150 thyroid cancer survivors established that SF-36 scores were worse during the first year but tended to recover over time. However, vitality and role-emotional limitations remain impaired [20]. The previously mentioned study by Hoftijzer et al. demonstrated similar results [15]. All scores improved with time, while TSH levels were clinically irrelevant. Our findings, which are to a certain degree in agreement with those of other studies concerning TSH levels, show a slight difference between patients with optimal and with sub-optimal TSH levels as concerns some aspects of SF-36 but not as regards BDI or BAI. Moreover, our findings showed that when intervals of hypothyroidism induced by discontinuation of thyroid hormone replacement are compared to intervals of subclinical hyperthyroidism, the prior are associated with lower quality of life scores. Several studies have validated this finding. Furthermore, as the duration of the peak hypothyroid period increases, the results worsen [21, 22]. We did not carry out a separate comparison

due to the small number of patients with iatrogenic hypothyroidism for a whole-body radioiodine scan.

In their study that included 316 subjects [14], Lee and associates found that thyroid cancer survivors had worse scores in cognitive, emotional, and social functioning than healthy controls. However, several other studies have indicated otherwise, although some of them are open to interpretation due to the number of patients and their design [23, 24]. It is noteworthy that two large-scale studies, which report no difference between patients and healthy controls, were performed in the Scandinavian countries, Sweden and Finland. This may reflect the general well-being of these countries [13, 25]. We have not gathered data on socioeconomic and sociocultural characteristics, which may be a shortcoming of our work.

We found no significant difference in SF-36, BDI, and BAI scores compared to patients who had received RAI treatment. The use of SF-36 in a series of 62 patients revealed that RAI treatment disrupted their quality of life acutely, but this effect disappeared after 6 months [23]. Findings by Almeida et al. are similar to our results, the authors reporting that quality of life was impaired at doses above 150 mCi [26]. In a study conducted at the University of California in 2013, RAI treatment was shown to cause chewing problems and, in general, impaired quality of life, with the impairment being dose-dependent [27]. The results of Taieb et al. are similar to those of our study. The patients were compared at the end of the month (RAI treatment months) and after 9 months, and no significant difference was found in anxiety, depression, and quality of life scores [28]. These different results may be due to intercommunal differences or to the fact that the scales used are not specifically developed for treatment of thyroid cancer and/or RAI. Likewise, with doses over 150 mCi, side effects are significantly increased [27]. In our cohort, only one patient received a dose over that threshold. If the complications of RAI treatment are considered to increase over 150 mCi, our negative results are not unexpected, since our cohort's mean dose is 100 mCi [29].

The strength of this study is that the participants were women, results from females more accurately reflecting the published research findings in terms of depression, anxiety, and thyroid cancer. The cross-sectional nature of our study is its main weakness, further weaknesses being that we do not have risk classification of all cases and some patients were initially treated in other intuitions. However, the number of patients and the use of validated studies strengthen the validity of the findings. The fact that most of our patients are in earlier stages of DTC can be considered either a positive or a negative aspect of our study depending on the approach. That is, it may be negative since it limits generalizability, but it can also be regarded as positive since it demonstrates that even early-stage thyroid cancer has detrimental effects on the subjects' well-being. In our study, the patient survival rate was between 1 and 23 years, with mean survival being 4.66 ± 3.04 years (Table 2). On this account, they were treated with different risk scales and approaches. We chose a TSH level of 2 as the cut-off to address the latter issue. Some patients had more extensive surgery in line with the guidelines of that particular year. A few patients had extensive surgery due to their surgeon's preference. This can also be mentioned as a weakness of our work.

In conclusion, our results showed that the HRQoL of patients with DTC was decreased compared to that of the control group and that depression and anxiety increased. Most patients in our cohort are at low risk according to the ATA guidelines. Furthermore, those patients who had early-stage DTC, who comprised the majority of our cohort, did not undergo extensive surgery, such as prophylactic/therapeutic lymph node dissections. In light of these findings, it is clear that even in the early stages, DTCs are strongly associated with poor quality of life, depression, and anxiety, despite their excellent prognosis. We also found that this finding was independent of RAI treatment. To sum up, our study presents strong evidence that DTCs disrupt women's quality of life and mental health.

We believe that patient education and support groups are essential to achieve improvement of HRQoL in thyroid cancer survivors. Routine psychiatric evaluation is also crucial to support these patients' emotional well-being.

Data availability Data is available upon contact with the corresponding author.

Declarations

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Research involving human participants and/or animals: this article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no competing interests.

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