Awareness of thyroid cancer among medical students: A questionnaire-based study

Penghao Liu, Jinkan Lin, Yongdu Nie, Zenghan Cao and Xiequn Xu
Department of General Surgery, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Abstract
To investigate whether medical students acquire enough knowledge about thyroid cancer (TC). It was a cross-sectional study in a Chinese medical college based on a questionnaire about the knowledge of TC and thyroid self-examination. Medical students enrolled were grouped into preclinical medical students (PMS) and clinical medical students (CMS) according to their grades. A total of 337 questionnaires were distributed and 274 effective responses were collected with 129 from PMS and 145 from CMS. The percentage of thyroid self-examination in CMS was higher than that of PMS (55.8% vs 11.6%, p < 0.001). Generally, CMS had better comprehension of TC, including prognosis (97.2% vs 64.5%, p < 0.001), diagnosis (95.6% vs 33.1%, p < 0.001), and surgery indications (82.1% vs 58.1%, p = 0.001). There was no significant difference between PMS and CMS on the acquaintance of the risk factors. However, more CMS stated that the below 5% of thyroid nodules might turn malignant (45.5% vs 6.5%, p < 0.001), and more CMS suggested that people without nodules should receive TC screening tests (62.1% vs 41.9%, p = 0.001). Medical education on TC was effective in teaching clinical knowledge. Medical school should focus more on preclinical general health education and clinical practices education in the future.

Keywords
thyroid cancer, questionnaire, medical students, self-examination

Introduction
Thyroid cancer (TC) is the most common head and neck malignancy, its incidence is increasing rapidly due to the well facilitated diagnosing techniques, which rose...
from 2.40/100,000 in 2003 to 13.75/100,000 in 2012 in China with an elevation rate of 20% every year. It has become one of the most common cancers in China as well as many other countries.\textsuperscript{1–3} It is more common in women and urban areas, and has a unique pattern of distribution along with age, which rises dramatically after ages of 15 years and peaks at 50–54 years. Mortality of TC increases with age in population.\textsuperscript{1}

TC has a better prognosis than other cancers, and it is often detected during physical examination without any symptoms. The clinical manifestations are palpable nodules, with occasional lymph nodes metastases, dysphagia, hoarseness, and dyspnea in advanced TC.\textsuperscript{4} Various risk factors correlate with its incidence, such as height, weight, cold weather, TSH levels, thyroiditis, and genetic mutations.\textsuperscript{5–11} To be noted, smoking and alcohol are correlated with decreases of TC incidence according to researches, but they can also lead to other diseases with worse prognosis.\textsuperscript{5,12,13}

Despite the favorable prognosis, TC patients are usually reported to suffer from unnecessary cancer-related worries for the sake of cancer progression, traumas of surgery, recurrence, death, and children.\textsuperscript{14–16} A research conducted in Thyroid Cancer Canada support group among TC survivors demonstrated that their worries were of middle levels on average, which were relevant with age, time of diagnosis, disease progression, and marital status.\textsuperscript{17} Another American survey of patients with well differentiated TC and favorable prognosis reported that over half of the patients showed worried about death, impaired quality of life, harms from treatments, recurrence, and family at risk.\textsuperscript{18} More worries were revealed in patients with lower education.

With the rapid development of Chinese social media, medical students as future physicians play an important role in public education. Mastering the knowledge of TC can encourage them to better promote public awareness, and to offer more professional suggestions to people with suspected thyroid nodules. Currently, there are surveys of cancer knowledge among medical students on melanoma and human papillomavirus (HPV)-induced oral cancer.\textsuperscript{19,20} Both indicated that medical education could bring effective information about cancer features, but still warranted efforts in practical application and clinical reasonings. Nonetheless, according to our knowledge, there has not been relevant researches focusing on TC education or thyroid self-examination.

This study is the first cross-sectional questionnaire-based analytical research on the knowledge of TC and thyroid self-examination among medical students.

**Methods**

**Study design and participants**

It was a transversal and quantitative study based on a questionnaire designed by the researchers. Participants were recruited from Peking Union Medical College (PUMC), covering all the third- and fourth-grade medical students. The third-grade medical students who had not received clinical courses were grouped into
preclinical medical students (PMS), and the fourth-grade medical students were grouped into clinical medical students (CMS).

The study was approved by the Ethics Committee of Peking Union Medical College Hospital (PUMCH).

**Questionnaire design**

The questionnaire covered the epidemiology, risk factors, self-examination, clinical diagnoses, and management of thyroid cancer. The database of Pubmed, Web of Science, and Scopus were searched using the terms “thyroid cancer” and “thyroid carcinoma,” and the latest and best matched researches were cited. The questionnaires were independently designed by two physicians of the Department of General Surgery in PUMCH, based on the above references and their experiences. The questionnaires were then revised by a senior professor and integrated into the final version, which were distributed and collected online.

**Statistical analysis**

All statistical analyses were conducted with IBM SPSS Statistics 23. Numerical variables were shown as average ± deviation (x ± s) and were processed by Shapiro-Wilke normality test. If the normality was justified, independent sample t-test was applied; if not, Mann-Whitney rank-sum test was applied. Categorical variables were shown as absolute and relative frequencies and were assessed by Chi-square and Fisher exact test. The level of significance is defined as p < 0.05 (95% confidence interval).

**Results**

This study was targeted toward PMS and CMS from PUMC, with a total of 337 students enrolled (PMS 151, CMS 186, Figure 1). There were 129 effective response questionnaires from PMS with a response rate of 85.4% and 145 effective responses questionnaires from CMS with a response rate of 78.0%. Fifty-two percent of the responded medical students were female, with no significant difference in performances compared with male peers (p = 0.148).

When enquired about thyroid self-examination, PMS and CMS responded differently (3.1% vs 11.0%, p < 0.001, see Table 1). The percentage of self-examination among CMS was higher than that among PMS (55.8% vs 11.6%, p < 0.001), but 80% (65/81) CMS among them did not perform regular examination. For those who did not examine thyroids regularly (including the ones who never examined and the ones who examined but not regularly), more PMS did not know how to examine thyroids (26.6% vs 5.4%, p < 0.001), and many CMS did not feel necessary (56.6%) or never thought about it (31.0%). As for other reasons, some deemed that the incidence of TC would be neglectable for them due to their young age. For those who ever examined their thyroid (including the ones who regularly examined and the ones who examined but not regularly), 97.5% (79/81)
CMS learned it from medical school with only 13.3% (2/15) PMS acquiring the knowledge in the same way ($p < 0.001$).

Assessing the awareness of TC, all CMS knew the existence of it while 3.9% PMS did not (see Table 2). Among the medical students who knew TC, there was significant difference in the knowledge of TC prognosis, with 97.2% CMS and 64.5% PMS who agreed on favorable prognosis for TC ($p < 0.001$), while a few PMS thought thyroid cancer had worse prognosis than other types of cancers (4.8% vs 0%, $p < 0.001$) and did not know its prognosis (21.0% vs 1.4%, $p < 0.001$). In both groups, there were over 1/3 of students whose relatives or friends had thyroid diseases (38.7% vs 34.5%, $p = 0.526$).

Considering their approaches to the knowledge of TC (see Table 2), most PMS acquired the main information from patients (themselves or others) of thyroid diseases (33.9%), media (61.3%), and self-interests (9.7%), barring those who knew nothing about the disease (10.5%). Most CMS get accessed to the knowledge through medical courses (95.9%).

When comparing the knowledge about the risk factors of TC (see Table 3), there was no significant difference between the two groups on alcohol, drinking, height, weight, stress, radiation, TSH levels, and “do not know.” However, more CMS selected cold weather (73.1% vs 16.9%, $p < 0.001$) and family history (91.7% vs
66.9%, \( p < 0.001 \). PMS and CMS also shared similar preferences on the malignancy of thyroid nodules, but more CMS thought that the malignancy ratio of thyroid nodules was below 5% (45.5% vs 6.5%, \( p < 0.001 \)). Most CMS knew the role ultrasound played in TC diagnosis, which was more than that in PMS (95.6% vs 33.1%, \( p < 0.001 \)). But more CMS suggested that even without symptoms or nodules, people still should check their thyroids under professional screening tests (62.1% vs 41.9%, \( p = 0.001 \)).

About TC treatment, more CMS chose not to perform surgery immediately after the diagnosis of TC (82.1% vs 58.1%, \( p = 0.001 \), see Table 4). Among those who answered “no” to this question, 84.0% CMS and 73.6% PMS knew there were observable microcarcinoma of thyroids (\( p = 0.094 \)). More CMS knew that thyroiditis was correlated with higher incidence of TC (57.2% vs 42.7%, \( p < 0.001 \)). In a word, when enquired about other treatments except surgery, CMS generally outperformed PMS.

**Discussion**

This is the first questionnaire-based study toward medical students to investigate how they mastered the features of TC and thyroid self-examination. The
Preliminary results demonstrated that most participants could grasp the general knowledge about TC, and CMS had superior performances considering diagnosis, treatments, and self-examination. Their knowledge mainly came from the medical courses. The results fully proved the efficiency of medical education in teaching TC.

CMS had a better performance in TC diagnosis, but many of them posed a more active attitude toward thyroid screening in asymptomatic people, which belongs to overdiagnosis according to current notions. As the convenience of current diagnosing techniques, the issues of population screening for TC are attracting more attention. South Korea launched a health screening program which increased the incidence of TC from 1999 to 2011 by 14 times, but no apparent benefits on mortality. The similar situation also occurred in America, with consistently increasing diagnosis of earlier TC but constant mortality rate. And an editorial article from Lancet in 2017 indicated that TC screening should not be encouraged. Besides, earlier intervention can also bring unnecessary harms and lawsuits. Therefore, thyroid screening in population should not be approved and healthy

### Table 2. Questionnaire analysis on basic knowledge of TC.

|                                | PMS (n = 129) | CMS (n = 145) | p Value |
|--------------------------------|---------------|---------------|---------|
|                                | Number  | Ratio % | Number  | Ratio % |         |
| Do you know about TC? (n = 274) |        |         |         |         | 0.022 \(F\) |
| Yes                            | 124  | 96.1    | 145  | 100    |         |
| No                             | 5  | 3.9     | 0  | 0.0    | <0.001 \(F\) |
| Do not know thyroids           | 0  | 0.0     | 0  | 0.0    |         |
| According to your knowledge, how is the prognosis of TC? (n = 269) |        |         |         |         | <0.001 \(F\) |
| Better than other cancers      | 80  | 64.5    | 141  | 97.2   |         |
| Close to other cancers         | 2  | 1.6     | 2  | 1.4    | >0.999 \(F\) |
| Worse than other cancers       | 6  | 4.8     | 0  | 0.0    | <0.001 \(F\) |
| Do not know                    | 36 | 21.0    | 2  | 1.4    | <0.001 \(F\) |
| Are there any relatives or friends of yours had thyroid diseases (not necessarily TC)? (n = 269) |        |         |         |         | 0.526 \(C\) |
| Yes                            | 48  | 38.7    | 50  | 34.5   |         |
| No                             | 76  | 61.3    | 95  | 65.5   |         |
| Where did you get most of the knowledge about TC (multiple choices)? (n = 269) |        |         |         |         |         |
| Myself or people around had thyroid diseases | 42  | 33.9    | 24  | 16.6   | 0.001 \(C\) |
| Media (telephone, TV, or ads)  | 53  | 42.7    | 23  | 15.9   | <0.001 \(C\) |
| Medical school                 | 54  | 43.5    | 139 | 95.9   | <0.001 \(C\) |
| Doctors                        | 30  | 24.2    | 28  | 19.3   | 0.373 \(C\) |
| Self-interests                 | 12  | 9.7     | 3  | 2.1    | 0.008 \(F\) |
| Do not know                    | 13  | 10.5    | 1  | 0.7    | <0.001 \(F\) |

CMS: clinical medical students; PMS: preclinical medical students; TC: thyroid cancer.

\(F\) Fisher’s exact test.

\(C\) Chi-square test.
Table 3. Questionnaire analysis on risk evaluation of TC.

| PMS (n = 129) | CMS (n = 145) | p Value | PMS (n = 129) |
|---------------|---------------|---------|---------------|
| Number        | Ratio %       | Number  | Number        |

Which of followings do you think are the risk factors for TC (multiple choices)? (n = 269)

| Risk Factor              | PMS (n = 129) | CMS (n = 145) | p Value |
|--------------------------|---------------|---------------|---------|
| Alcohol                  | 52            | 39            | 0.010   |
| Smoking                  | 53            | 71            | 0.328   |
| Height                   | 3             | 6             | 0.513   |
| Weight                   | 53            | 50            | 0.169   |
| Stress                   | 84            | 88            | 0.253   |
| Cold weather             | 21            | 106           | < 0.001 |
| Radiation                | 80            | 120           | 0.157   |
| First-grade relatives    | 83            | 133           | < 0.001 |
| Higher TSH level         | 98            | 118           | 0.647   |
| Do not know              | 11            | 4             | 0.035   |

What is the malignancy frequency if you found a thyroid nodule? (n = 269)

| Frequency               | PMS (n = 129) | CMS (n = 145) | p Value |
|-------------------------|---------------|---------------|---------|
| 25–35%                  | 1             | 3             | 0.627   |
| 15%–25%                 | 10            | 7             | 0.321   |
| 5%–15%                  | 14            | 27            | 0.125   |
| 5% or below             | 8             | 66            | < 0.001 |
| Do not know             | 91            | 42            | < 0.001 |

What is the first test to do to screen for TC if you have a thyroid nodule? (n = 269)

| Test                    | PMS (n = 129) | CMS (n = 145) | p Value |
|-------------------------|---------------|---------------|---------|
| FNA                     | 21            | 23            | 0.869   |
| Ultrasound              | 41            | 110           | < 0.001 |
| Cervical CT             | 6             | 8             | > 0.999 |
| Cervical MRI            | 2             | 1             | 0.596   |
| Do not know             | 54            | 3             | < 0.001 |

Whether should people without symptoms or thyroid nodules receive screening tests for TC? (n = 269)

| Decision                | PMS (n = 129) | CMS (n = 145) | p Value |
|-------------------------|---------------|---------------|---------|
| Yes                     | 52            | 90            | 0.001   |
| No                      | 24            | 42            | 0.088   |
| Do not know             | 48            | 13            | < 0.001 |

CMS: clinical medical students; FNA: fine needle aspiration; MRI: magnetic resonance imaging; PMS: preclinical medical students; TC: thyroid cancer; TSH: thyroid stimulating hormone.

Footnotes:
- *Fisher’s exact test.
- ^Chi-square test.

people without symptoms or thyroid nodules should avoid frequent screening tests for TC.

About the managements, CMS also had obvious advantages over PMS. The most effective strategy is surgery, and nowadays, physicians are more encouraged to perform the individualized regimens according to images and fine needle aspiration (FNA) cytology, as Bethesda system. Nevertheless, there are certain probabilities of trauma pertaining to surgery. Surgeons are facing more challenges on how to set distinguish those patients with observable thyroid microcarcinomas.
Miyauchi\textsuperscript{29} actively monitored 1179 low-risk TC patients without surgery for 47 months, and there were no TC-related mortality or distant metastases. Meanwhile, 92.0% of patients avoided thyroidectomy and only 4.3% decided to receive surgery based on their own choices without disease progression. Although over 1/3 patients reported cancer-related worries during the follow-up, 83% of patients were satisfied with this regimen, and their worries were relieved with time passing by.\textsuperscript{30} Therefore, surgeons can actively monitor the patients if their TC fits the conditions for clinically observable microcarcinomas, which supports the above statements against early detection of TC.\textsuperscript{28}

The medical students performed generally well in the part of basic knowledge, however, those who could regularly examine their thyroids were scarce. 85.5% (230/269) of medical students were aware of how to self-examine thyroids, but only 41.7% (96/230) of them had ever examined themselves. Most medical students who did not examined themselves regularly chose “never thought about it” (39.4%) and

| Should surgeries be performed immediately after the diagnosis of TC? (n = 269) | PMS (n = 129) | CMS (n = 145) | p Value | PMS (n = 129) |
|---|---|---|---|---|
| Number | Ratio % | Number | Number | Number |
| Yes | 9 | 43 | 22 | 15.2 | 0.021 \textsuperscript{F} |
| No\textsuperscript{a} | 72 | 58.1 | 119 | 82.1 | 0.001 \textsuperscript{C} |
| Do not know | 43 | 34.7 | 4 | 2.8 | <0.001 \textsuperscript{F} |

If no, do you know some thyroid microcarcinomas could be monitored without surgery? (n = 191)\textsuperscript{a}

| Yes | 53 | 73.6 | 100 | 84.0 | — |
| No | 19 | 26.4 | 19 | 16.0 | — |

If combined with thyroiditis, does the severity of it correlates with the incidence of TC and its prognosis? (n = 269)

| Yes | 53 | 42.7 | 83 | 57.2 | <0.001 \textsuperscript{C} |
| No | 1 | 0.8 | 22 | 15.2 | <0.001 \textsuperscript{F} |
| Do not know | 70 | 56.4 | 40 | 27.6 | <0.001 \textsuperscript{C} |

What are other treatments for TC except surgeries (multiple choices)? (n = 269)

| Radionuclide therapy | 64 | 51.6 | 56 | 38.6 | 0.037 \textsuperscript{C} |
| TSH suppression therapy | 66 | 53.2 | 95 | 65.5 | 0.046 \textsuperscript{C} |
| External radiation therapy | 48 | 38.7 | 79 | 54.5 | 0.010 \textsuperscript{C} |
| Chemotherapy | 56 | 45.2 | 57 | 39.3 | 0.386 \textsuperscript{C} |
| Immunotherapy | 45 | 36.3 | 37 | 25.5 | 0.063 \textsuperscript{C} |
| Do not know | 43 | 34.7 | 5 | 3.4 | <0.001 \textsuperscript{F} |

CMS: clinical medical students; PMS: preclinical medical students; TC: thyroid cancer; TSH: thyroid stimulating hormone.

\textsuperscript{a}Fisher’s exact test.

\textsuperscript{C}Chi-square test.

\textsuperscript{a}No means the answer “no” in the question “Should surgeries be performed immediately after the diagnosis of TC!”
“feel unnecessary” (39.4%), the percentage of which was higher in CMS. It denoted that as CMS learned more about TC, they might grow less careful. In line with this, most CMS presumed lower than 5% of malignancy for thyroid nodules, but researches revealed that 5%–15% of nodules might turn malignant.31 Besides, some answers declared that they would not have TC because of young age. However, epidemiological studies reported that a relatively high proportion of teenagers were diagnosed with TC, though of good prognosis.1 Our results also showed a high incidence of thyroid diseases among the medical students’ relatives and friends. Based on these results, medical students might be too optimistic to ignore the necessities of self-examination.

This study provided evidence to support the necessity and efficiency in TC education. CMS performed better in questions enquiring about TC characteristics, diagnosis, and treatments, but they tended to be less cautious because of the good prognosis of the disease. Furthermore, the health education was not enough for PMS, not to mention the public awareness of TC, which might lead to the improper management and unnecessary anxiety. The appropriate attitude toward TC should focus on self-examination, while unnecessary screening without any symptoms or nodules should be avoided. If there are nodules, one should seek professional advice from physicians and receive well-facilitated diagnosing tests without exaggerative worries. Doctors are entrusted with various responsibilities beside treatment, for instance, other non-therapeutic consultation like public health education, earlier diagnosis, and prevention, which seem more fundamental with such severe anxiety for TC. As future doctors, medical students are important in tackling and relieving this cancer-related worries through public health education. And they may take on a more indispensable role when they grasp enough knowledge of TC.

There are several limitations to this study. The study was confined to a single medical school in China with a relatively limited sample size, who might not well represent the whole population of medical students. The questionnaire about the basic knowledge and self-examination is self-designed with previous application, thus lacking parallel control from other studies as well as available evidence supporting the efficiency of this questionnaire. Besides, the questionnaire was distributed through the Internet, and the environment where the participants answered these questions were not unified. Also, whether they checked or searched for the answers was unknown to us and this limitation might lead to false better results.

**Conclusions**

This study is the first questionnaire-based study focusing on the features of TC and thyroid self-examination in medical school. Our results proved the significance of medical education in teaching TC theories, as CMS generally outperformed PMS in the comprehension of diagnosis and clinical managements. Nevertheless, CMS were over optimistic about TC and needed more awareness of cost-effectiveness in thyroid screening as well as the necessities of thyroid self-examination. Besides,
PMS lacked basic understanding of TC, which urgently required more attention to preclinical general health education. Medical school should also concentrate more on the clinical practices and non-therapeutic experiences of TC in the future, to better promote the social effects of medical students on public health education.

**Author contributions**

Study design and manuscript were written by PL and XX. Questionnaires distribution and analytical analysis were conducted by JL, YN, and ZC. Manuscript was revised and by XX. Corresponding authors were XX.

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by the National Natural Science Foundation of China (No. 32071436) and by a grant (2019ZLGC0111) from the Medical Education Reform Project of Peking Union Medical College, Beijing, China.

**Ethics 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 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of Peking Union Medical College Hospital (PUMCH).

**Informed consent**

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

**ORCID iD**

Xiequn Xu [https://orcid.org/0000-0003-0347-5258](https://orcid.org/0000-0003-0347-5258)

**Availability of data and material**

The datasets used or analyzed during the current study are available from the corresponding author on reasonable request.

**References**

1. Du L, Li R, Ge M, et al. Incidence and mortality of thyroid cancer in China, 2008-2012. *Chin J Cancer Res* 2019; 31: 144–151.
2. Chen WQ, Li H, Sun KX, et al. [Report of cancer incidence and mortality in China, 2014]. Zhonghua Zhong Liu Za Zhi 2018; 40: 5–13.
3. Guay B, Johnson-Obaseki S, McDonald JT, et al. Incidence of differentiated thyroid cancer by socioeconomic status and urban residence: Canada 1991-2006. Thyroid 2014; 24: 552–555.
4. Cabanillas ME, McFadden DG and Durante C. Thyroid cancer. Lancet 2016; 388: 2783–2795.
5. Guignard R, Truong T, Rougier Y, et al. Alcohol drinking, tobacco smoking, and anthropometric characteristics as risk factors for thyroid cancer: a countrywide case-control study in New Caledonia. Am J Epidemiol 2007; 166: 1140–1149.
6. Haymart MR, Glinberg SL, Liu J, et al. Higher serum TSH in thyroid cancer patients occurs independent of age and correlates with extrathyroidal extension. Clin Endocrinol (Oxf) 2009; 71: 434–439.
7. Xiao Y, Zhou Q, Xu Y, et al. Positive thyroid antibodies and risk of thyroid cancer: a systematic review and meta-analysis. Mol Clin Oncol 2019; 11: 234–242.
8. Liu Y, Li C, Zhao W, et al. Hashimoto’s thyroiditis is an important risk factor of papillary thyroid microcarcinoma in younger adults. Horm Metab Res 2017; 49: 732–738.
9. Ernaga-Lorea A, Hernández-Morhain MC, Anda-Apíñániz E, et al. Prognostic value of change in anti-thyroglobulin antibodies after thyroidectomy in patients with papillary thyroid carcinoma. Clin Transl Oncol 2018; 20: 740–744.
10. Trimboli P, Zilioli V, Imperiali M, et al. Thyroglobulin autoantibodies before radioiodine ablation predict differentiated thyroid cancer outcome. Clin Chem Lab Med 2017; 55: 1995–2001.
11. Allen NE, Beral V, Casabonne D, et al. Moderate alcohol intake and cancer incidence in women. J Natl Cancer Inst 2009; 101: 296–305.
12. Kitahara CM, Linet MS, Beane Freeman LE, et al. Cigarette smoking, alcohol intake, and thyroid cancer risk: a pooled analysis of five prospective studies in the United States. Cancer Causes Control 2012; 23: 1615–1624.
13. Allen NE, Beral V, Casabonne D, et al. Moderate alcohol intake and cancer incidence in women. J Natl Cancer Inst 2009; 101: 296–305.
14. Simard S, Thewes B, Humphris G, et al. Fear of cancer recurrence in adult cancer survivors: a systematic review of quantitative studies. J Cancer Surviv 2013; 7: 300–322.
15. Ness S, Kokal J, Fee-Schroeder K, et al. Concerns across the survivorship trajectory: results from a survey of cancer survivors. Oncol Nurs Forum 2013; 40: 35–42.
16. Sung TY, Shin YW, Nam KH, et al. Psychological impact of thyroid surgery on patients with well-differentiated papillary thyroid cancer. Qual Life Res 2011; 20: 1411–1417.
17. Bresner L, Banach R, Rodin G, et al. Cancer-related worry in Canadian thyroid cancer survivors. J Clin Endocrinol Metab 2015; 100: 977–985.
18. Papaleontiou M, Reyes-Gastelum D, Gay BL, et al. Worry in thyroid cancer survivors with a favorable prognosis. Thyroid 2019; 29: 1080–1088.
19. Keser G, Yilmaz G and Pekiner FN. Assessment of knowledge level and awareness about human papillomavirus among dental students. J Cancer Educ. Epub ahead of print 2 January 2020. DOI: 10.1007/s13187-019-01683-3.
20. Kalil LL, Prado EHM, Resende RVU, et al. Melanoma awareness among medical students. J Cancer Educ. Epub ahead of print 4 January 2020. DOI: 10.1007/s13187-019-01685-1.
21. Takano T. Natural history of thyroid cancer [Review]. Endocr J 2017; 64: 237–244.
22. Brito JP, Gionfriddo MR, Al Nofal A, et al. The accuracy of thyroid nodule ultrasound to predict thyroid cancer: systematic review and meta-analysis. *J Clin Endocrinol Metab* 2014; 99: 1253–1263.
23. Ahn HS, Kim HJ and Welch HG. Korea’s thyroid-cancer “epidemic”-screening and overdiagnosis. *N Engl J Med* 2014; 371: 1765–1767.
24. Lin JS, Bowles EJA, Williams SB, et al. Screening for thyroid cancer: updated evidence report and systematic review for the US preventive services task force. *JAMA* 2017; 317: 1888–1903.
25. Olson E, Wintheiser G, Wolfe KM, et al. Epidemiology of thyroid cancer: a review of the national cancer database, 2000-2013. *Cureus* 2019; 11: e4127.
26. The Lancet. Thyroid cancer screening. *Lancet* 2017; 389: 1954.
27. Crippa S, Mazzucchelli L, Cibas ES, et al. The Bethesda system for reporting thyroid fine-needle aspiration specimens. *Am J Clin Pathol* 2010; 134: 343–345.
28. Roman BR, Morris LG and Davies L. The thyroid cancer epidemic, 2017 perspective. *Curr Opin Endocrinol Diabetes Obes* 2017; 24: 332–336.
29. Miyauchi A. Clinical trials of active surveillance of papillary microcarcinoma of the thyroid. *World J Surg* 2016; 40: 516–522.
30. Davies L, Roman BR, Fukushima M, et al. Patient experience of thyroid cancer active surveillance in Japan. *JAMA Otolaryngol Head Neck Surg* 2019; 145: 363–370.
31. Frates MC, Benson CB, Doubilet PM, et al. Prevalence and distribution of carcinoma in patients with solitary and multiple thyroid nodules on sonography. *J Clin Endocrinol Metab* 2006; 91: 3411–3417.

**Author biographies**

**Penghao Liu** received the BS degree in School of Life Sciences from Tsinghua University, Beijing, China, in 2018 and he is currently working toward the M.D. degree in Surgery with PUMC, Beijing, China. His research interests include Head and Neck Cancer.

**Jinkan Lin** received the BS degree in School of Life Sciences from Tsinghua University, Beijing, China, in 2019 and he is currently working toward the M.D. degree in Surgery with PUMC, Beijing, China. His research interests include Head and Neck Cancer.

**Yongdu Nie** received the BS degree in School of Life Sciences from Tsinghua University, Beijing, China, in 2020 and he is currently working toward the M.D. degree in Surgery with PUMC, Beijing, China. His research interests include Head and Neck Cancer.

**Zenghan Cao** received the BS degree in School of Life Sciences from Tsinghua University, Beijing, China, in 2021 and he is currently working toward the M.D. degree in Surgery with PUMC, Beijing, China. His research interests include Head and Neck Cancer.

**Xiequn Xu** received his BS degree in School of Life Sciences from Peking University, Beijing, China, and his M.D. degree in PUMC, Beijing China, in 2002. He is currently professor in Department of General Surgery in PUMCH, Beijing, China. His research interests include Head and Neck Cancer and carcinoma of gallbladder.