

**Table 3.** Demographics of the 200 cases of papillary thyroid cancer (PTC) diagnosed by fine-needle aspiration cytology in 11,389 persons during the years 1988-2010 and 5-year-classes thereof (except the last three years)

	1988-2010	1988-1992	1993-1997	1998-2002	2003-2007	2008-2010
Total FNAC (females, males)	11,389 (9,341, 2,048)	510 (426, 84)	1,076 (915, 161)	2,494 (2,097, 397)	4,440 (3,627, 813)	2,869 (2,276, 593) <sup>c</sup>
Number of PTC (PTC – per time period- as % of Total No. of PTC)	200 (100%)	7 (3.5%)	13 (6.5%)	32 (16%)	92 (46%)	56 (93) <sup>c</sup> (28%)
F: M ratio in PTC	3.8:1	7:0	5.5:1	4.3:1	4.7:1	2.1:1 (2.0:1) <sup>c</sup>
No. of PTC, m ± SD per year (all)	8.7 ± 8.1	1.4 ± 1.1	2.6 ± 2.1	6.4 ± 2.9	18.4 ± 5.5	18.7 ± 1.5 (18) <sup>c</sup>
% PTC in females as % total FNAC in females <sup>a</sup>	1.69%	1.64%	1.20%	1.24%	2.09%	1.67%
% PTC in males as % of total FNAC in males <sup>b</sup>	2.05%	0	1.24%	1.51%	1.97%	3.04%
PTC as % of all PTC	100 % [n=200]	3.5%	6.5%	16%	46%	28% (31.2%) <sup>c</sup>
PTC, age (years) of all patients	42.4 ± 15.1	41.1 ± 14.3	47.3 ± 17.2	41.7 ± 14.5	41.8 ± 15.0	42.8 ± 15.6
PTC, age (years) of female patients	42.9 ± 14.9	41.1 ± 14.3	47.7 ± 18.7	42.5 ± 13.9	42.6 ± 14.8	42.6 ± 15.1
PTC, age (years) of male patients	40.8 ± 16.2	N/A	45.0 ± 8.5	38.5 ± 18.2	38.5 ± 16.0	43.1 ± 17.1

<sup>a</sup>Pearson's correlation coefficient of the four percentages over time was not statistically significant ( $r = 0.427$ ,  $P = 0.473$ ).

<sup>b</sup>Pearson's correlation coefficient of the four percentages over time was trendwise significant ( $r = 0.962$ ,  $P < 0.001$ ).

<sup>c</sup>In parenthesis, projection over the 5-year period 2008-2012, if trend persists.

**Table 4.** Summary of the international literature on the detection of papillary thyroid cancer (PTC) in patients who underwent fine-needle aspiration cytology (FNAC) for single or multiple thyroid nodules over a period comparable to that of the present study<sup>a</sup>

Continent, Country	Year(s) of study	Reference	FNAC	Frequency of PTC (% of total FNAC)
Europe, Italy	1988 – 2010 (23 years)	Rizzo, 2012 (this study)	11,389 FNAC on 11,389 patients with single or dominant nodule who underwent <b>US-FNAC</b> . Adequate FNAC = 11,258 (98.8%, on 11,258 patients). The number of adequate FNAC increased linearly from a minimum of 73 in 1988 to a maximum of 1,069 in 2008, a 15-fold change ( $r = 0.956, P < 0.001$ ).	PTC = 200/11389 (1.8%) <sup>b</sup> In percentage the increase was from 0% in 1988 to 1.97% in 2010 ( $P = 0.062$ by correlation), with a peak of 2.6% in 2006. Moreover, colloid goiter and chronic lymphocytic thyroiditis were the only categories that increased at a linear rate in percentage ( $P < 0.001$ )
Europe, Italy	1997 – 2004 (8 years)	Rago, 2010 <sup>5</sup>	FNA cytology in 47,775 nodules from 34,266 patients.	2.4% were indicative or suspicious for carcinoma
Europe, The Netherlands	1989 – 2003 (15 years)	Netea – Maier, 2008 <sup>6</sup>	Between 1989 and 2003 a total of 44,141 FNAB were performed. The number of FNABs performed each year progressively increased from 1,093 in 1989 to 4,123 in 2003.	A diagnosis of thyroid cancer (TC) was made in 2,493 cases (5.6%) based on FNAB. The number of TCs at cytopathological examination also increased yearly by 9.5% ( $P < 0.0001$ ). Therefore, the proportion of TC diagnosed or suspected at cytological examination among all of the performed FNAB did not change during the study period ( $P = 0.07$ ). However, there was a slight increase in incidence of PTC of 2.1% per year ( $P < 0.001$ ) particularly in stage I tumors, possibly, in part, because of a marked increase in use of FNAB.
Europe, Czech Republic	1986 – 2002 (17 years)	Martinek, 2004 <sup>7</sup>	In the period 1986–2002, 781 FNACs on 245 persons with focal lesions in the thyroid gland. Adequate aspirates in 213 persons.	PTC in 28/245 cases (11.4%). Percentage of PTC on adequate FNAC = 13.1% (28/213).
Europe, Greece	1993 – 2003 (11 years)	Zagorianakou, 2005 <sup>8</sup>	A total of 900 patients, between 1993 and 2003, who had palpable or visible thyroid nodule by ultrasonography, underwent FNA. In 179 (19.9%) FNA was inadequate.	PTC in 21/900 cases (2.3%). Percentage of PTC on adequate FNAC = 2.9% (21/721).
N. America, USA (Massachusetts)	1995 – 2003 (9 years)	Frates, 2006 <sup>9</sup>	2,208 patients had at least one thyroid nodule larger than 10 mm in maximal diameter and underwent <b>US-guided FNAC</b> . Adequate cytology = 1,985.	PTC in 261/2,208 cases (11.8%). Percentage of PTC on adequate FNAC = 13.1% (261/1,985).
N. America, USA (New York)	1986 – 1996 (11 years)	Charles, 1997 <sup>10</sup>	Review of 422 patients who underwent thyroid surgery. All patients had FNAB prior to surgery. Adequate cytology = 400.	PTC in 81/422 patients (19.2%) on FNAC. Percentage of PTC on adequate FNAC = 20.2% (81/400).
N. America, USA (Miami and Nashville)	2003 – 2009 (7 years)	Lew, 2011 <sup>11</sup>	A retrospective review of prospectively collected data of 797 consecutive patients with dominant nodules >1 cm who underwent FNA and thyroidectomy.	147/797 (18.4%) positive for malignancy, 85/797 (10.7%) suspicious for PTC.

**Table 4.** (Continued) Summary of the international literature on the detection of papillary thyroid cancer (PTC) in patients who underwent fine-needle aspiration cytology (FNAC) for single or multiple thyroid nodules over a period comparable to that of the present study<sup>a</sup>

Continent, Country	Year(s) of study	Reference	FNAC	Frequency of PTC (% of total FNAC)
Oceania, Australia (region of Tasmania)	1988 – 1998 (11 years)	Burgess, 2006 <sup>12</sup>	A total of 3,452 individuals underwent a thyroid procedure, comprising 1,968 surgical and 1,756 FNAB cytologic procedures in 1,532 patients. Thyroidectomy and thyroid FNAB increased by 7% and 49.7% per annum, respectively.	184 patients were diagnosed with TC (confirmed by histology), of whom 121/1,532 (7.9%) had <b>PTC</b> . The likelihood of diagnosing a PTC in any given thyroidectomy specimen increased from 3.3% in 1988 to 7.7% in 1998. Diagnoses of <b>PTC</b> in patients previously assessed by FNAB increased by 99.7% per year (P <0.005).
Asia, Taiwan	1986 – 1999 (14 years)	Lin, 2005 <sup>13</sup>	21,748 patients examined in one medical center (FNAC considered the first-line examination procedure).	Malignancy on cytology = 740 / 21,748 (3.4%). Particularly, 424 / 21,748 patients (1.94%) were confirmed by histology.
Asia, Korea	1999 – 2001 (3 years)	Ko, 2003 <sup>14</sup>	Among 1,613 consecutive FNAs of the thyroid, 207 patients (12.8%) who underwent both FNAs and surgery were selected for review. Adequate cytology= 1,532 (95%).	Malignancy in 118/1,613 (7.4%) FNAs. Of 207 thyroid lesions who underwent both FNAs and surgery, 98 were <b>PTC</b> (98/1,613= 6.1%).
Asia, Korea	2000 – 2001 (2 years)	Nam-Goong, 2004 <sup>15</sup>	317 nodules (all impalpable) from 267 patients who underwent <b>US-FNAC</b> . Cytological diagnosis included 101 inadequate specimens (32%)	42/317 (nodules) were <b>PTC</b> (13.2%). Percentage of <b>PTC</b> on adequate FNAC= 19.4% (42/216).
Asia, Korea	2003 – 2006 (4 years)	Choi, 2008 <sup>16</sup>	2,614 patients underwent <b>US-guided FNAC</b> , of whom 392 (15.0%) were inadequate. 343/2,614 underwent thyroidectomy.	- 311/2,614 (11.8%) malignant or suspicious for malignancy; - 73/2,614 were indeterminate; - 1,838/2,614 benign. - 198/343 were <b>PTC</b> on histology.
Asia, Korea	03/2006 – 02/2008 (2 years)	Choi, 2008 <sup>17</sup>	658 FNAC in 658 patients. Inadequate specimens were 96 (13.7%).	- 79 (12%) positive malignancy of whom 46 underwent thyroidectomy (43/79 were <b>PTC</b> at histology); - 22 indeterminate cytology.
Asia, China	12/1999 – 12/2003 (4 years)	Cheung, 2007 <sup>18</sup>	Total FNAC= 179 Inadequate FNAC= 32 (17.9%).	27/179 (15.1%) <b>PTC</b> or suspicious for <b>PTC</b> .
Asia, Yemen	1997 – 2001 (5 years)	Al-Hureibi, 2003 <sup>19</sup>	243 FNAs due to thyroid swellings.	4 (1.6%) suspicious for <b>PTC</b> , 7 (2.9%) <b>PTC</b> .
Africa, Kenya	10/1994 – 04/2002 (7.58 years)	El Hag, 2003 <sup>20</sup>	303 patients with thyroid swellings underwent FNA	Neoplasia (13.9%).

<sup>a</sup>These studies were retrieved through a PubMed search by entering the strings: “Papillary thyroid carcinoma AND FNA” or “Thyroid carcinoma AND FNA” or “Thyroid cancer AND FNA” or “Thyroid nodule AND FNA”.

<sup>b</sup>To permit comparison with other cohorts of this table, rate of malignancy is 2.32% (1.8% PTC + 0.17% ATC + 0.11% MTC + 0.24% OML), while rate of malignancy and suspicious for malignancy combined is 2.56% (2.32% + 0.24%). Interestingly, results in our study reported in Table 1 on MTC show a lower frequency of MTC with respect to the Czech Republic and Korea, a higher frequency with respect to Taiwan, China and the USA, and similar results with respect to The Netherlands.