*SupplementaryMaterials*

# Genomic and Transcriptomic Characteristics According to Size of Papillary Thyroid Microcarcinoma

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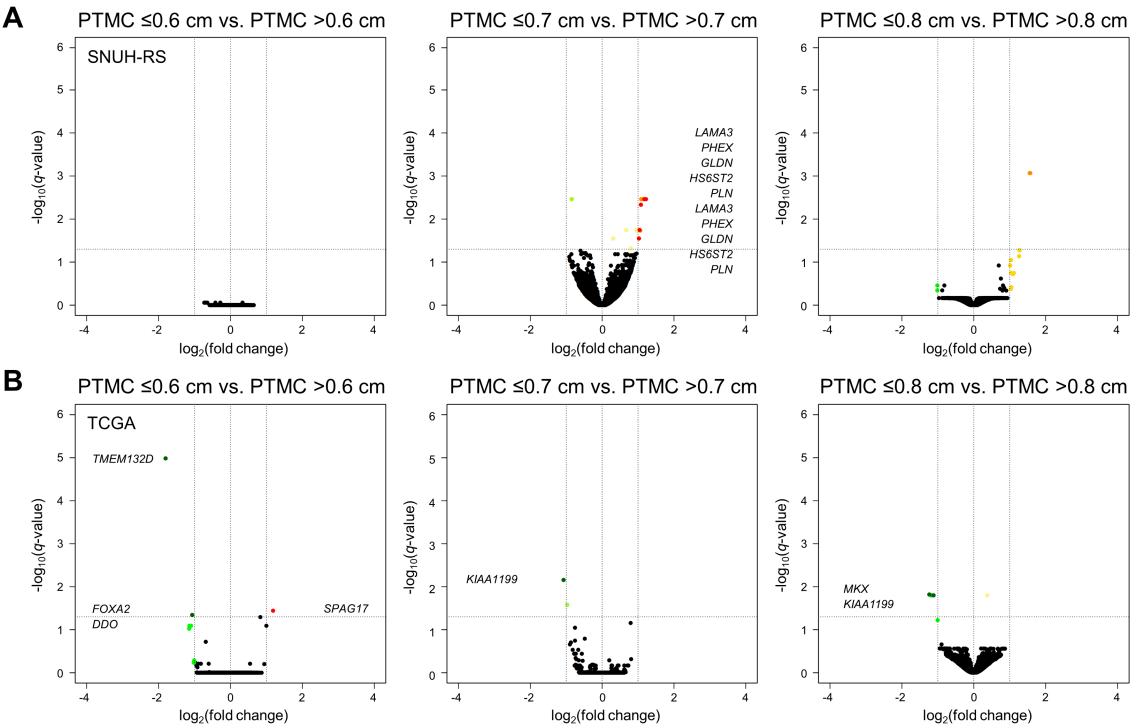


**Figure S1.** Transcriptomic characteristics of *BRAF*-mutant papillary thyroid microcarcinoma according to tumor size. Volcano plots showing differential RNA expression levels between groups of *BRAF*-mutant PTMCs: ≤0.6 cm vs. >0.6 cm (left), ≤0.7 cm vs. >0.7 cm (middle), and ≤0.8 cm vs. >0.8 cm (right) from the **(A)** SNUH RNA-sequencing (SNUH-RS, n = 11 vs.. 18, 18 vs. 11, 22 vs. 7, respectively) and **(B)** TCGA (n = 3 vs. 15, 6 vs. 12, 7 vs. 11, respectively) datasets. PTMC, papillary thyroid microcarcinoma.

**Table S1.** Information of datasets included in the study.

| Dataset | No. of total PTCs | No. of PTMCs | Sequencing type | Information used for analysis |
|---|---|---|---|---|
| SNUH (1) | 221 [a] | 93 [a] | Targeted sequencing; Sanger sequencing | Mutations of 612 genes and *TERT* promoter |
| (2) | 312 [b] | 123 [b] | Sanger sequencing | Mutations of $BRAF^{V600E}$, *RAS*, and *TERT* promoter |
| (3) | 2282 [b] | 1687 [b] | Sanger sequencing | $BRAF^{V600E}$ mutation |
| (4) | 124 | 43 | RNA sequencing; Sanger sequencing | Mutations of $BRAF^{V600E}$, *RAS*, and *TERT* promoter; Whole transcriptome |
| TCGA (5) | 496 | 39 | Whole exome/genome sequencing; Targeted sequencing; RNA sequencing | Mutations of whole genes and *TERT* promoter; Whole transcriptome |
| Total | 3435 | 1985 | | |

(1) New dataset of this study, using targeted sequencing and Sanger sequencing for *TERT* promoter mutations (represented as the SNUH targeted-sequencing dataset (SNUH-TS) in figures).

(2) Song, Y.S.; Lim, J.A.; Choi, H.; Won, J.K.; Moon, J.H.; Cho, S.W.; Lee, K.E.; Park, Y.J.; Yi, K.H.; Park, D.J., et al. Prognostic effects of *TERT* promoter mutations are enhanced by coexistence with *BRAF* or *RAS* mutations and strengthen the risk prediction by the ATA or TNM staging system in differentiated

thyroid cancer patients. *Cancer* **2016**, *122*, 1370-1379.
(3) Hong, A.R.; Lim, J.A.; Kim, T.H.; Choi, H.S.; Yoo, W.S.; Min, H.S.; Won, J.K.; Lee, K.E.; Jung, K.C.; Park, D.J., et al. The frequency and clinical implications of the *BRAF*(V600E) mutation in papillary thyroid cancer patients in Korea over the past two decades. *Endocrinol Metab (Seoul)* **2014**, *29*, 505-513.
(4) Yoo, S.K.; Lee, S.; Kim, S.J.; Jee, H.G.; Kim, B.A.; Cho, H.; Song, Y.S.; Cho, S.W.; Won, J.K.; Shin, J.Y., et al. Comprehensive analysis of the transcriptional and mutational landscape of follicular and papillary thyroid cancers. *PLoS Genet* **2016**, *12*, e1006239 (represented as the SNUH RNA-sequencing dataset (SNUH-RS) in figures).
(5) Cancer Genome Atlas Research Network. Integrated genomic characterization of papillary thyroid carcinoma. *Cell* **2014**, *159*, 676-690 (represented as the Cancer Genome Atlas dataset (TCGA) in figures).
[a] PTCs were selected if the residual DNA was available for additional sequencing analysis, among the PTCs in Datasets (2) and (3).
[b] The number of PTCs in Studies (2) and (3) is the number except when included in Dataset (1).

**Table S2.** List of genes included in the SNUH targeted-sequencing dataset.

| **Kinase Genes (*n* = 566)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| *AAK1* | *AATK* | *ABL1* | *ABL2* | *ACTR2* | *ACVR1* | *ACVR1B* | *ACVR1C* |
| *ACVR2A* | *ACVR2B* | *ACVRL1* | *ADCK1* | *ADCK4* | *ADCK5* | *ADRBK1* | *ADRBK2* |
| *AGK* | *AKT1* | *AKT2* | *AKT3* | *ALK* | *ALPK1* | *ALPK2* | *ALPK3* |
| *AMHR2* | *ANKK1* | *ARAF* | *ATM* | *ATR* | *AURKA* | *AURKB* | *AURKC* |
| *AXL* | *BCKDK* | *BLK* | *BMP2K* | *BMPR1A* | *BMPR1B* | *BMPR2* | *BMX* |
| *BRAF* | *BRD2* | *BRD3* | *BRD4* | *BRDT* | *BRSK1* | *BRSK2* | *BTK* |
| *BUB1* | *BUB1B* | *C9orf96* | *CABC1* | *CAMK1* | *CAMK1D* | *CAMK1G* | *CAMK2A* |
| *CAMK2B* | *CAMK2D* | *CAMK2G* | *CAMK4* | *CAMKK1* | *CAMKK2* | *CAMKV* | *CASK* |
| *CCRK* | *CDC2* | *CDC2L2* | *CDC2L5* | *CDC2L6* | *CDC42BPA* | *CDC42BPB* | *CDC42BPG* |
| *CDC7* | *CDK10* | *CDK2* | *CDK3* | *CDK4* | *CDK5* | *CDK6* | *CDK7* |
| *CDK8* | *CDK9* | *CDKL1* | *CDKL2* | *CDKL3* | *CDKL4* | *CDKL5* | *CERK* |
| *CHEK1* | *CHEK2* | *CHUK* | *CIT* | *CLK1* | *CLK2* | *CLK3* | *CLK4* |
| *CNKSR2* | *CRKRS* | *CSF1R* | *CSK* | *CSNK1A1* | *CSNK1A1L* | *CSNK1D* | *CSNK1E* |
| *CSNK1G1* | *CSNK1G2* | *CSNK1G3* | *CSNK2A1* | *CSNK2A2* | *DAPK1* | *DAPK2* | *DAPK3* |
| *DCLK1* | *DCLK2* | *DCLK3* | *DDR1* | *DDR2* | *DGKA* | *DGKB* | *DGKD* |
| *DGKE* | *DGKG* | *DGKH* | *DGKI* | *DGKQ* | *DGKZ* | *DMPK* | *DSTYK* |
| *DYRK1A* | *DYRK1B* | *DYRK2* | *DYRK3* | *DYRK4* | *EEF2K* | *EGFR* | *EIF2AK1* |
| *EIF2AK2* | *EIF2AK3* | *EIF2AK4* | *EPHA1* | *EPHA10* | *EPHA2* | *EPHA3* | *EPHA4* |
| *EPHA5* | *EPHA6* | *EPHA7* | *EPHA8* | *EPHB1* | *EPHB2* | *EPHB3* | *EPHB4* |
| *EPHB6* | *ERBB2* | *ERBB3* | *ERBB4* | *ERN1* | *ERN2* | *FASTK* | *FER* |
| *FES* | *FGFR1* | *FGFR2* | *FGFR3* | *FGFR4* | *FGR* | *FLJ25006* | *FLT1* |
| *FLT3* | *FLT4* | *FRK* | *FYN* | *GAK* | *GCK* | *GRK1* | *GRK4* |
| *GRK5* | *GRK6* | *GRK7* | *GSG2* | *GSK3A* | *GSK3B* | *GUCY2C* | *GUCY2D* |
| *GUCY2F* | *HCK* | *HIPK1* | *HIPK2* | *HIPK3* | *HIPK4* | *HSPB8* | *HUNK* |
| *ICK* | *IGF1R* | *IKBKB* | *IKBKE* | *ILK* | *INSR* | *INSRR* | *IP6K1* |
| *IP6K2* | *IP6K3* | *IPMK* | *IPPK* | *IRAK1* | *IRAK2* | *IRAK3* | *IRAK4* |
| *ITK* | *ITPK1* | *ITPKA* | *ITPKB* | *ITPKC* | *JAK1* | *JAK2* | *JAK3* |
| *KALRN* | *KDR* | *KIAA1804* | *KIT* | *KSR1* | *KSR2* | *LATS1* | *LATS2* |
| *LCK* | *LIMK1* | *LIMK2* | *LMTK2* | *LMTK3* | *LRRK1* | *LRRK2* | *LTK* |
| *LYN* | *MAK* | *MAP2K1* | *MAP2K2* | *MAP2K3* | *MAP2K4* | *MAP2K5* | *MAP2K6* |
| *MAP2K7* | *MAP3K1* | *MAP3K10* | *MAP3K11* | *MAP3K12* | *MAP3K13* | *MAP3K14* | *MAP3K15* |
| *MAP3K2* | *MAP3K3* | *MAP3K4* | *MAP3K5* | *MAP3K6* | *MAP3K7* | *MAP3K8* | *MAP3K9* |
| *MAP4K1* | *MAP4K2* | *MAP4K3* | *MAP4K4* | *MAP4K5* | *MAPK1* | *MAPK10* | *MAPK11* |
| *MAPK12* | *MAPK13* | *MAPK14* | *MAPK15* | *MAPK3* | *MAPK4* | *MAPK6* | *MAPK7* |
| *MAPK8* | *MAPK9* | *MAPKAPK2* | *MAPKAPK3* | *MAPKAPK5* | *MARK1* | *MARK2* | *MARK3* |
| *MARK4* | *MAST1* | *MAST2* | *MAST3* | *MAST4* | *MASTL* | *MATK* | *MELK* |
| *MERTK* | *MET* | *MGC42105* | *MINK1* | *MKNK1* | *MKNK2* | *MLKL* | *MOS* |
| *MST1R* | *MST4* | *MTOR* | *MUSK* | *MYLK* | *MYLK2* | *MYLK3* | *MYLK4* |
| *MYO3A* | *MYO3B* | *NEK1* | *NEK10* | *NEK11* | *NEK2* | *NEK3* | *NEK4* |
| *NEK5* | *NEK6* | *NEK7* | *NEK8* | *NEK9* | *NLK* | *NPR1* | *NPR2* |
| *NRBP1* | *NRBP2* | *NRK* | *NTRK1* | *NTRK2* | *NTRK3* | *NUAK1* | *NUAK2* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *OBSCN* | *OXSR1* | *PAK1* | *PAK2* | *PAK3* | *PAK4* | *PAK6* | *PAK7* |
| *PASK* | *PBK* | *PCTK1* | *PCTK2* | *PCTK3* | *PDGFRA* | *PDGFRB* | *PDIK1L* |
| *PDK1* | *PDK2* | *PDK3* | *PDK4* | *PDPK1* | *PFTK1* | *PFTK2* | *PHKG1* |
| *PHKG2* | *PI4K2A* | *PI4K2B* | *PI4KA* | *PI4KB* | *PIK3C2A* | *PIK3C2B* | *PIK3C2G* |
| *PIK3C3* | *PIK3CA* | *PIK3CB* | *PIK3CD* | *PIK3CG* | *PIK3R1* | *PIK3R2* | *PIK3R3* |
| *PIK3R4* | *PIK3R5* | *PIK3R6* | *PIKFYVE* | *PIM1* | *PIM2* | *PIM3* | *PINK1* |
| *PIP4K2A* | *PIP4K2B* | *PIP4K2C* | *PIP5K1A* | *PIP5K1B* | *PIP5K1C* | *PIP5KL1* | *PIPSL* |
| *PKLR* | *PKMYT1* | *PKN1* | *PKN2* | *PKN3* | *PLK1* | *PLK2* | *PLK3* |
| *PLK4* | *PNCK* | *PRAGMIN* | *PRKAA1* | *PRKAA2* | *PRKACA* | *PRKACB* | *PRKACG* |
| *PRKCA* | *PRKCB* | *PRKCD* | *PRKCE* | *PRKCG* | *PRKCH* | *PRKCI* | *PRKCQ* |
| *PRKCZ* | *PRKD1* | *PRKD2* | *PRKD3* | *PRKDC* | *PRKG1* | *PRKG2* | *PRKX* |
| *PRKY* | *PRPF4B* | *PSKH1* | *PSKH2* | *PTK2* | *PTK2B* | *PTK6* | *PTK7* |
| *PXK* | *RAC1* | *RAF1* | *RAGE* | *RET* | *RIOK1* | *RIOK2* | *RIOK3* |
| *RIPK1* | *RIPK2* | *RIPK3* | *RIPK4* | *RNASEL* | *ROCK1* | *ROCK2* | *ROR1* |
| *ROR2* | *ROS1* | *RPS6KA1* | *RPS6KA2* | *RPS6KA3* | *RPS6KA4* | *RPS6KA5* | *RPS6KA6* |
| *RPS6KB1* | *RPS6KB2* | *RPS6KC1* | *RPS6KL1* | *RYK* | *SBK1* | *SBK2* | *SCYL1* |
| *SCYL2* | *SCYL3* | *SGK1* | *SGK196* | *SGK2* | *SGK269* | *SGK3* | *SGK493* |
| *SIK1* | *SIK2* | *SIK3* | *SLK* | *SMG1* | *SNRK* | *SPEG* | *SPHK1* |
| *SPHK2* | *SRC* | *SRM* | *SRMS* | *SRPK1* | *SRPK2* | *SRPK3* | *STK10* |
| *STK11* | *STK16* | *STK17A* | *STK17B* | *STK19* | *STK24* | *STK25* | *STK3* |
| *STK31* | *STK32A* | *STK32B* | *STK32C* | *STK33* | *STK35* | *STK36* | *STK38* |
| *STK38L* | *STK39* | *STK4* | *STK40* | *STRADA* | *STRADB* | *STYK1* | *SYK* |
| *TAF1* | *TAF1L* | *TAOK1* | *TAOK2* | *TAOK3* | *TBCK* | *TBK1* | *TEC* |
| *TEK* | *TESK1* | *TESK2* | *TEX14* | *TGFBR1* | *TGFBR2* | *TIE1* | *TLK1* |
| *TLK2* | *TNIK* | *TNK1* | *TNK2* | *TNNI3K* | *TP53RK* | *TRIB1* | *TRIB2* |
| *TRIB3* | *TRIM24* | *TRIM28* | *TRIM33* | *TRIO* | *TRPM6* | *TRPM7* | *TRRAP* |
| *TSSK1B* | *TSSK2* | *TSSK3* | *TSSK4* | *TSSK6* | *TTBK1* | *TTBK2* | *TTK* |
| *TTN* | *TXK* | *TYK2* | *TYRO3* | *UHMK1* | *ULK1* | *ULK2* | *ULK3* |
| *ULK4* | *VRK1* | *VRK2* | *VRK3* | *WEE1* | *WEE2* | *WNK1* | *WNK2* |
| *WNK3* | *WNK4* | *YES1* | *YSK4* | *ZAK* | *ZAP70* | | |
| Cancer-related genes other than kinase genes (n =46) | | | | | | | |
| *APC* | *BRCA1* | *BRCA2* | *CCND1* | *CCND2* | *CCND3* | *CDC6* | *CDH1* |
| *CDKN2A* | *CDKN2B* | *CHD3* | *COL1A1* | *CTNNB1* | *ESR1* | *ESR2* | *FBXW7* |
| *GAB1* | *GATA3* | *HAUS3* | *HRAS* | *IDH1* | *IDH2* | *INPP4A* | *IRS2* |
| *IRS4* | *KIAA1468* | *KLHL4* | *KRAS* | *MLH1* | *MYC* | *NF1* | *NF2* |
| *NFKB1* | *NFKBIA* | *NFKBIE* | *NRAS* | *PALB2* | *PTEN* | *RB1* | *RHEB* |
| *RNF220* | *SNX4* | *SP1* | *TERT* | *TP53* | *USP28* | | |