

# Supplementary information for ADNIC validation experiments

## Overview

These supplementary tables summarize the validation experiments used to evaluate robustness, imbalance handling, component contribution, backbone choice, and training-configuration sensitivity. The expanded validation suite contained 110 completed model-training and evaluation tasks, with no failed runs. Unless otherwise noted, values in repeated-seed or cross-validation tables are reported as mean  $\pm$  standard deviation.

Table S1: Repeated-seed comparison of representative methods on the held-out test split

Method	Seeds	Overall Acc. (%)	Macro F1	Period 3 F1
EfficientNetV2-S + CE	10	86.52 $\pm$ 5.34	0.7435 $\pm$ 0.0873	0.4602 $\pm$ 0.2275
EfficientNetV2-S + fixed Focal Loss	10	85.94 $\pm$ 2.56	0.7404 $\pm$ 0.0599	0.4547 $\pm$ 0.1724
EfficientNetV2-S + adaptive Focal Loss	10	86.67 $\pm$ 4.31	0.7694 $\pm$ 0.0836	0.5418 $\pm$ 0.2015
Single-stage contrastive ADNIC	10	87.97 $\pm$ 3.81	0.7812 $\pm$ 0.0486	0.5408 $\pm$ 0.0898
ADNIC	10	88.99 $\pm$ 2.48	0.7912 $\pm$ 0.0524	0.5607 $\pm$ 0.1280

Table S2: Expanded baseline comparison on the held-out test split

Method	Overall Acc. (%)	Macro F1	Period 3 F1
Cross-entropy	83.33	0.7578	0.5714
Weighted cross-entropy	86.11	0.7889	0.6154
Oversampling + cross-entropy	90.28	0.8132	0.6000
Feature-space SMOTE	77.78	0.6354	0.3077
Fixed Focal Loss	90.28	0.8600	0.7692
Adaptive Focal Loss	91.67	0.8870	0.8333
Contrastive branch only	87.50	0.7980	0.6154
Single-stage contrastive ADNIC	88.89	0.8662	0.8571

Table S3: Component ablation on the held-out test split

Variant	Overall Acc. (%)	Macro F1	Period 3 F1
A1: cross-entropy	83.33	0.7578	0.5714
A2: fixed Focal Loss	90.28	0.8600	0.7692
A3: adaptive Focal Loss	91.67	0.8870	0.8333
A4: contrastive branch only	87.50	0.7980	0.6154
A5: single-stage contrastive ADNIC	88.89	0.8662	0.8571
A6: default ADNIC	84.72	0.7117	0.4000
A7: ADNIC without Stage 2 contrastive term	83.33	0.7086	0.4444
A8: ADNIC with 50/50 stage allocation	87.50	0.8118	0.6667

Table S4: Five-fold cross-validation results

Method	Folds	Overall Acc. (%)	Macro F1	Period 3 F1
Cross-entropy	5	92.40 $\pm$ 0.84	0.8541 $\pm$ 0.0391	0.6907 $\pm$ 0.1075
Adaptive Focal Loss	5	91.23 $\pm$ 1.03	0.8508 $\pm$ 0.0211	0.7075 $\pm$ 0.0561
ADNIC	5	91.23 $\pm$ 1.88	0.8344 $\pm$ 0.0602	0.6536 $\pm$ 0.1840

Table S5: Backbone comparison under the ADNIC training protocol

Backbone	Params (M)	Overall Acc. (%)	Macro F1	Period 3 F1
ResNet50	23.5	86.11	0.7932	0.6667
EfficientNetV2-S	20.2	84.72	0.7802	0.6250
ConvNeXt-Tiny	27.8	59.72	0.2493	0.0000
ViT-B/16	85.8	61.11	0.4563	0.1667
Swin-T	27.5	59.72	0.2493	0.0000

Table S6: Optimisation validation of ADNIC variants across five repeated seeds

Variant	Seeds	Overall Acc. (%)	Macro F1	Period 3 F1
Adaptive focal, $\gamma = 1.5$	5	85.51 $\pm$ 2.90	0.7502 $\pm$ 0.0654	0.5105 $\pm$ 0.1690
Single-stage ADNIC-lite, $\gamma = 1.5$	5	83.19 $\pm$ 3.01	0.6979 $\pm$ 0.0442	0.3841 $\pm$ 0.0978
Two-stage ADNIC, 50/50, $\beta = 0.7$ , $\gamma = 1.5$	5	88.12 $\pm$ 2.59	0.7936 $\pm$ 0.0538	0.5910 $\pm$ 0.1518
Two-stage ADNIC, 50/50, $\beta = 0.7$ , $\gamma = 2.0$	5	87.83 $\pm$ 2.63	0.7901 $\pm$ 0.0591	0.5850 $\pm$ 0.1609

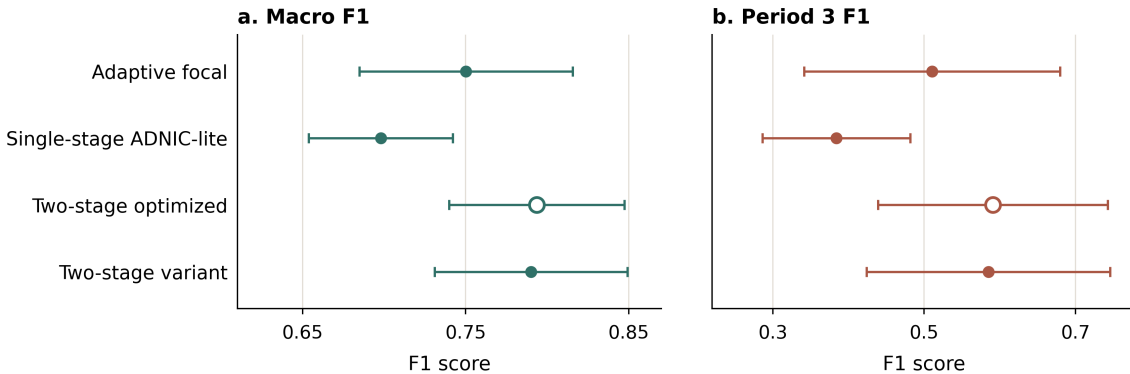


Figure S1: Visual summary of optimisation-validation variants. Points and error bars show mean  $\pm$  SD across five repeated seeds. Open markers indicate the best variant in each panel. The corresponding numerical values and parameter settings are reported in Table S6.

Table S7: Stage-ratio sensitivity on the held-out test split

Stage allocation	Overall Acc. (%)	Macro F1	Period 3 F1
30/70	83.33	0.7230	0.4615
40/60	84.72	0.7117	0.4000
50/50	87.50	0.8118	0.6667
60/40	87.50	0.8118	0.6667

Table S8: Stage 2 contrastive-weight sensitivity on the held-out test split

$\beta$	<b>Overall Acc. (%)</b>	<b>Macro F1</b>	<b>Period 3 F1</b>
0.0	83.33	0.7086	0.4444
0.05	83.33	0.7230	0.4615
0.1	84.72	0.7117	0.4000
0.2	83.33	0.7230	0.4615
0.3	83.33	0.7230	0.4615
0.5	83.33	0.7230	0.4615
0.7	90.28	0.8583	0.7500
1.0	86.11	0.7984	0.6667

Table S9: Focal-loss focusing-parameter sensitivity on the held-out test split

$\gamma$	<b>Overall Acc. (%)</b>	<b>Macro F1</b>	<b>Period 3 F1</b>
0.5	90.28	0.8660	0.7692
1.0	90.28	0.8845	0.8750
1.5	93.06	0.9218	0.9231
2.0	90.28	0.8600	0.7692
2.5	87.50	0.7879	0.6000
3.0	87.50	0.8627	0.8571
3.5	90.28	0.8974	0.9231
4.0	87.50	0.8209	0.7143

Table S10: Contrastive temperature sensitivity on the held-out test split

$\tau$	<b>Overall Acc. (%)</b>	<b>Macro F1</b>	<b>Period 3 F1</b>
0.03	86.11	0.7407	0.4615
0.05	81.94	0.6390	0.2222
0.07	87.50	0.7771	0.5455
0.10	87.50	0.7419	0.4444
0.15	90.28	0.8314	0.6667
0.20	86.11	0.7529	0.5000
0.25	90.28	0.8120	0.6000
0.30	84.72	0.7700	0.6154