

Supplementary Data to the Manuscript

Diabetes detection from whole-body magnetic resonance imaging using deep learning

by

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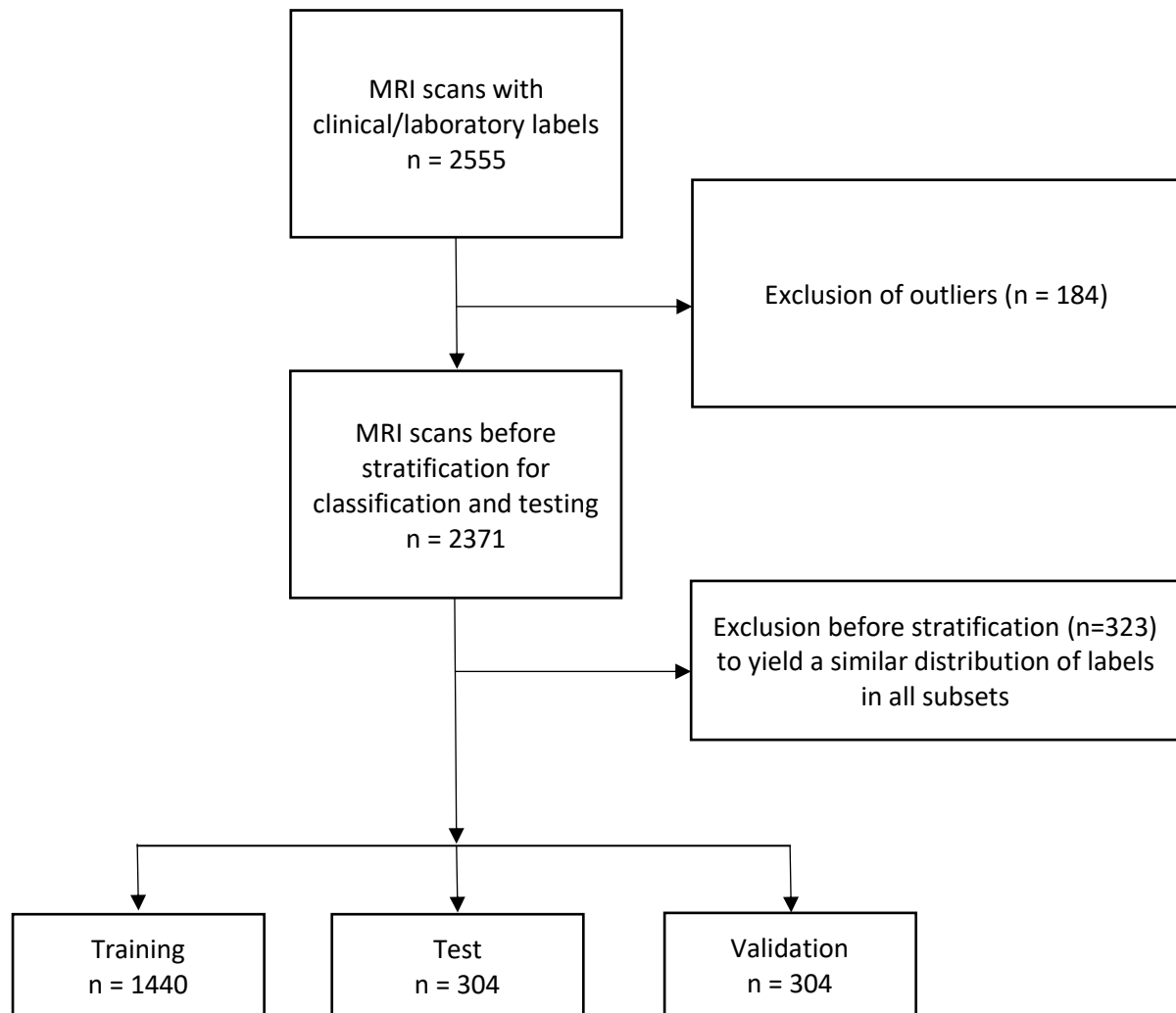
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Supplementary Figures

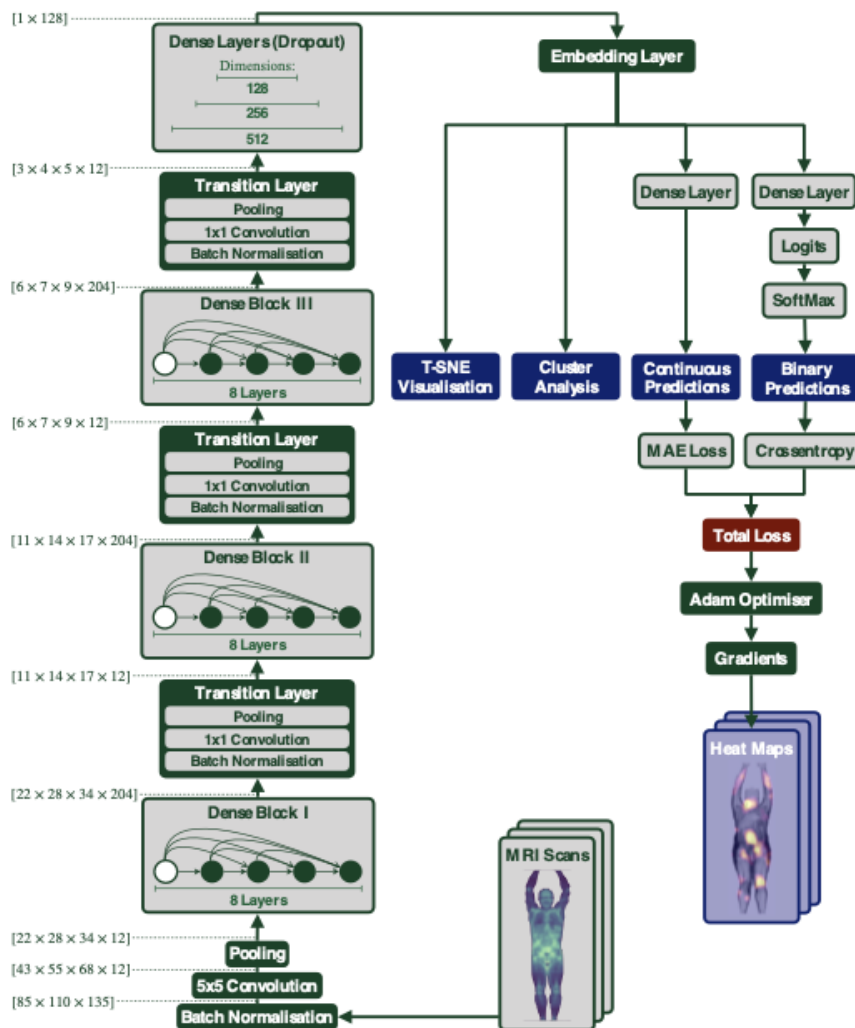
Supplementary Figure 1

Study flow chart on the pre-processing of available images



Supplementary Figure 2

Schematic of Model Architecture.

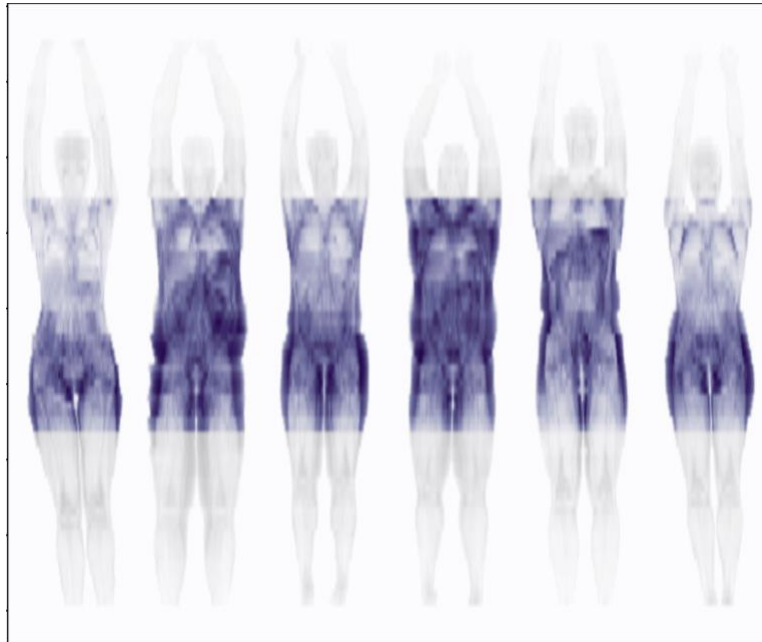


The input to the network consisted of mini-batches of three-dimensional MRI scans. The input was passed to a batch normalisation layer as well as an initial convolution and pooling operation. Afterwards, three dense blocks were built in series with transition layers following each dense block. Finally, we used a series of densely connected layers with dropout to map the output of the final transition layer to the embedding layer of dimension 1×128 (Dimensions between network layers were denoted on the left). The embedding layer was used as input for post-processing and predictions. We optimized the sum of all prediction losses to optimize the network and used the trained model to generate gradient maps.

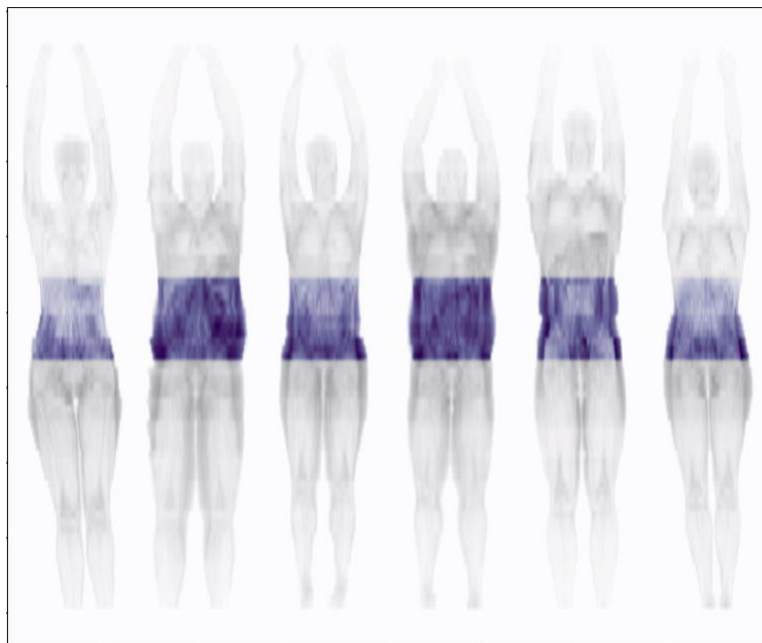
Supplementary Figure 3

Restricted anatomic regions selected for alternative training approaches (A. Torso, B. Abdominal region). For results, see Supplementary Table 2.

A



B



Supplementary Tables

Supplementary Table 1

Demographic, clinical and laboratory data corresponding to the MR images used for training, test and validation

	Overall
Number of scans	2048
Number of study participants	790
subjects according to number of measurements (%)	
1 measurement	265 (33.6)
2 measurements	201 (25.4)
3-4 measurements	218 (27.6)
>4 measurements	106 (13.4)
elapsed days since previous measurement (mean (SD))	419.07 (732.78)
sex = male (%)	788 (38.5)
age (mean (SD))	50.23 (12.93)
BMI (kg/m ²) (mean (SD))	29.34 (5.15)
waist circumference (cm) (mean (SD))	96.21 (13.62)
hip circumference (cm) (mean (SD))	106.92 (10.95)
systolic blood pressure (mean (SD))	131.17 (17.00)
diastolic blood pressure (mean (SD))	83.01 (11.72)
heart rate (mean (SD))	69.60 (10.93)
fasting glucose (mmol/l) (mean (SD))	5.41 (0.58)
post-challenge glucose (mmol/l) (mean (SD))	6.95 (1.88)
glycemic category (%)	
NGT	1103 (53.9)
IFG	375 (18.3)
IGT	263 (12.8)
IFG+IGT	192 (9.4)
DIA	115 (5.6)
glycated hemoglobin (mmol/mol) (mean (SD))	38.04 (4.30)
triglycerides (mmol/l) (mean (SD))	1.40 (1.07)

	Overall
insulin sensitivity (Matsuda) (mean (SD))	13.90 (8.98)
fasting insulin (pmol/l) (mean (SD))	64.47 (42.24)
insulinogenic index (mean (SD))	123.59 (122.24)
disposition index (mean (SD))	1535.14 (3233.94)
cholesterol (mmol/l) (mean (SD))	5.09 (0.98)
LDL (mmol/l) (mean (SD))	3.08 (0.84)
HDL (mmol/l) (mean (SD))	1.38 (0.34)
aspartate-aminotransferase (mean (SD))	24.25 (11.94)
alanine-aminotransferase (mean (SD))	27.09 (15.81)
gamma-glutamyl transferase (mean (SD))	27.75 (25.47)
serum creatinine (mg/dl) (mean (SD))	0.81 (0.16)

Supplementary Table 2

Diagnostic precision of different model setups showing AUC-ROC results for four labels. Zooming was performed by applying random zooming on the image.

	Gender	Prediabetes	Diabetes	Diabetes with IFG+IGT
All data with repeated measurements				
Whole body, default augmentation	0.99	0.69	0.87	0.72
Zooming	0.99	0.62	0.87	0.71
Torso only*	0.99	0.60	0.67	0.74
Torso only* with zooming	0.99	0.63	0.77	0.73
Abdomen only**	0.99	0.61	0.83	0.71
Abdomen only** with zooming	0.99	0.63	0.71	0.70
One measurement per participant				
Whole body, default augmentation	0.97	0.68	0.79	0.71

Restricted image analyses were performed with *torso only (neck to upper thigh region excluding the extremities, see Supplementary Figure 3.A) and **abdomen only (diaphragm to hip, see Supplementary Figure 3.B).