

# Intravoxel Incoherent Motion MRI of the Healthy Pancreas: Monoexponential and Biexponential Apparent Diffusion Parameters and Age Correlations

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**TARGET AUDIENCE:** Researchers in the field of pancreatic MRI.

## PURPOSE:

It is known that changes in composition and/or cellularity of tissues would influence the diffusion of water molecules in the human body, and that these changes can be quantified by apparent diffusion coefficient (ADC) based on DWI. As a person ages, pancreas would show several age-related structural changes such as atrophy, fatty infiltration, and fibrosis. The age-related proportional changes may also have a significant influence on ADCs in the healthy pancreas. Recently, the effect of age on ADC values of normal pancreas has been reported.<sup>1,2</sup> However, both a significant decline with ages<sup>1</sup> and lack of association<sup>2</sup> with age of ADCs have been reported. These reports, however, used only two b values to measure ADC values. Ideally, multiple b values DWI with intravoxel incoherent motion (IVIM) model should be set up for the separate estimation of tissue perfusion and diffusivity. Thus, the aim of the study was to identify potential associations between the DWI-derived IVIM parameters such as f (perfusion fraction), ADC<sub>fast</sub> (pseudo-diffusion coefficient), ADC<sub>slow</sub> (the tissue diffusivity) and these parameters with the commonly used DWI-derived ADCs of normal pancreas and the age.

## METHODS:

Fifty-seven healthy volunteers (36 males and 21 females; mean age, 45.0±5.8 years) were recruited for the study. Respiratory-trigger DWI of the pancreas was performed at 3T using 9 b-values (0, 20, 50, 100, 200, 400, 600, 800 and 1000 s/mm<sup>2</sup>). ADC was calculated for all b-values using linear regression yielding ADC<sub>total</sub>. The ADC<sub>b</sub> of the monoexponential DWI, slow component of diffusion (ADC<sub>slow</sub>), incoherent microcirculation (ADC<sub>fast</sub>) and perfusion fraction (f) of the biexponential DWI were calculated for pancreas head, body and tail. The association between ADC value and age was analyzed by Pearson correlation.

## RESULTS:

All of the multi-b-value DWI derived parameters of normal pancreas were presented in **Table 1**. A significant decline with age were observed for ADC<sub>400</sub> (P=0.032), ADC<sub>800</sub> (P=0.004), ADC<sub>1000</sub> (P=0.034), ADC<sub>total</sub> (P=0.016), ADC<sub>fast</sub> (P=0.01) and ADC<sub>slow</sub> (P=0.022) (**Fig. 1**). However, no significant association were observed for ADC<sub>20</sub>, ADC<sub>50</sub>, ADC<sub>100</sub>, ADC<sub>200</sub>, ADC<sub>600</sub> and f of normal adult pancreas across different ages (P = 0.072-0.871).

## CONCLUSIONS:

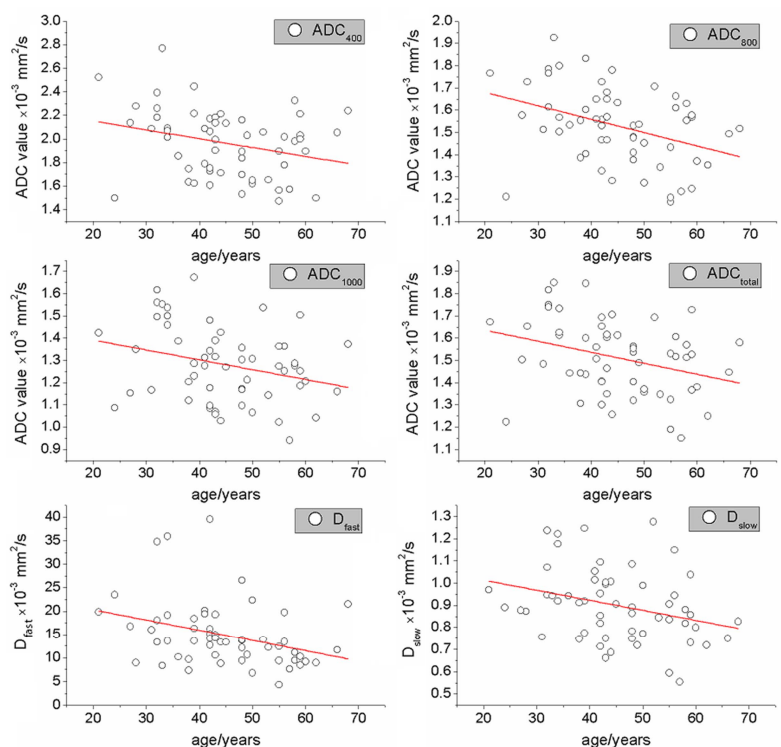
Multi-b-value DWI derived parameters including ADC<sub>400</sub>, ADC<sub>800</sub>, ADC<sub>1000</sub>, ADC<sub>total</sub>, ADC<sub>fast</sub> and ADC<sub>slow</sub> of normal pancreas decline with age. This finding suggests that, when using multi-b-value DWI, the effect of age on the parameters should be taken in to account when using them to the diagnosis of pancreatic diseases and design of future studies.

## REFERENCES:

- Herrmann J, Schoennagel BP, Roesch M, et al. *J Magn Reson Imaging*. 2013;37(4):886-91.
- Ma C, Pan CS, Zhang HG, et al. *Clin Radiol*. 2013;68(10):e532-7.

**Table 1.** Comparison of ADCs According to Age. \*Pearson correlation test.

	head	body	tail	mean	correlation	P*
ADC <sub>20</sub>	9.01±3.76	9.92±4.48	8.79±3.70	9.24±4.00	0.022	0.871
ADC <sub>50</sub>	5.19±2.07	5.77±2.34	5.11±1.88	5.36±2.11	-0.162	0.229
ADC <sub>100</sub>	3.72±1.60	3.87±1.48	3.20±1.03	3.59±1.41	-0.187	0.164
ADC <sub>200</sub>	2.61±0.82	2.65±0.77	2.34±0.57	2.53±0.74	-0.174	0.196
ADC <sub>400</sub>	2.03±0.52	2.08±0.52	1.78±0.35	1.96±0.49	-0.284	<b>0.032</b>
ADC <sub>600</sub>	1.76±0.38	1.78±0.34	1.59±0.26	1.71±0.34	-0.24	0.072
ADC <sub>800</sub>	1.61±0.34	1.57±0.26	1.41±0.25	1.53±0.30	-0.38	<b>0.004</b>
ADC <sub>1000</sub>	1.31±0.25	1.33±0.23	1.20±0.18	1.28±0.23	-0.282	<b>0.034</b>
ADC <sub>total</sub>	1.56±0.30	1.57±0.24	1.41±0.19	1.51±0.26	-0.319	<b>0.016</b>
ADC <sub>fast</sub>	14.05±8.31	15.21±10.69	15.18±8.91	14.81±9.32	-0.34	<b>0.01</b>
ADC <sub>slow</sub>	0.92±0.26	0.91±0.25	0.87±0.20	0.90±0.23	-0.303	<b>0.022</b>
f (%)	0.39±0.12	0.40±0.12	0.33±0.09	0.37±0.11	0.048	0.723



**Fig.1** Global pancreatic multi-b-value DWI derived parameters values according to age.