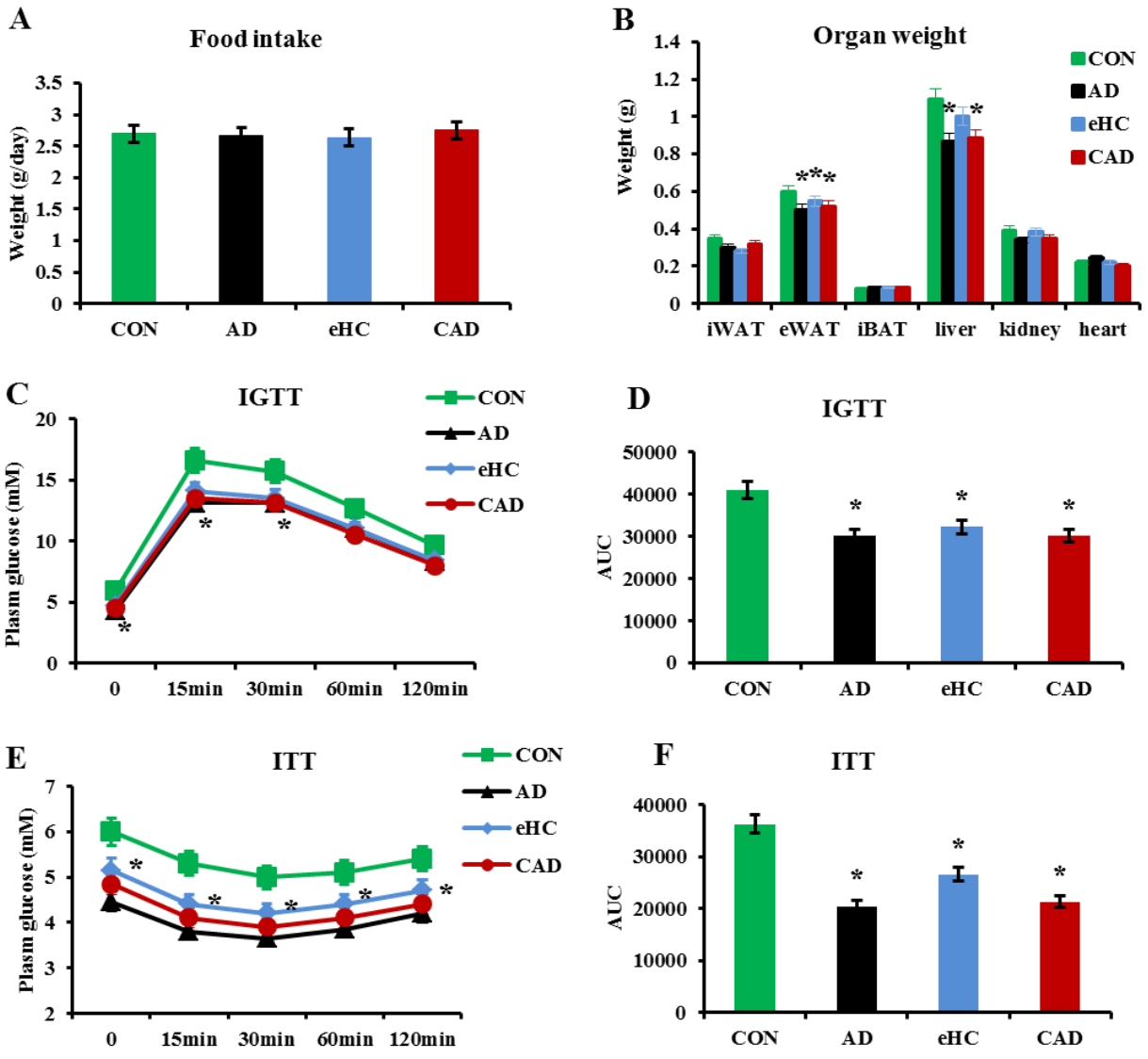
Supplementary data:

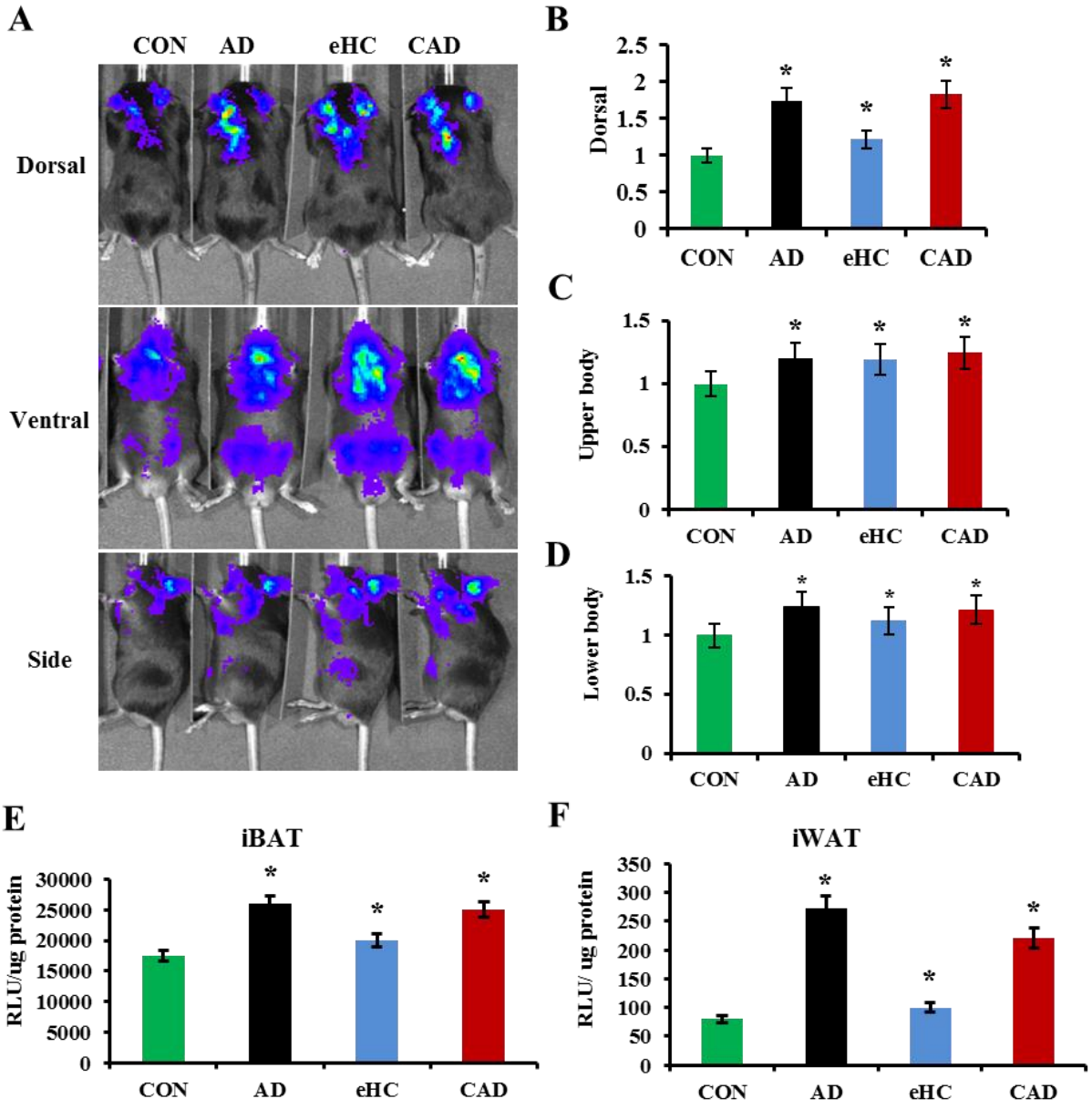
S1. Early nutritional interventions improved glucose tolerance.

(A) Food intake every day; (B) Organ weights. (C-D) IGTT was performed through intraperitoneal injection of glucose into mice after 12 h fasting, and blood glucose levels were measured at 0, 15, 30, 60, and 120 min later; AUC was analyzed by the soft of Image J. (E-F) ITT was performed through intraperitoneal injection of insulin into mice after 6h fasting, and blood glucose levels were measured at 0, 15, 30, 60, and 120 min later; AUC was analyzed by the soft of Image J. IGTT, glucose tolerance test; ITT, insulin tolerance test; CON, control group; AUC, area under the curve; iBAT, interscupular BAT; iWAT, inguinal WAT; eWAT, epididymal WAT. *p < 0.05 vs. CON.



S2. AD and casein enhances *Ucp1* expression in mice.

(A) Luminescence images of Ucp1$^{+/LUC}$ mice in response to ARA, DHA and casein diets; (B-D) Quantification of luminescence for the dorsal, the chest and neck and abdomen view images in response to ARA, DHA and casein diets shown in (A). (E) Luciferase enzymatic activity in iBAT in response to ARA, DHA and casein diets; (F) Luciferase enzymatic activity in iWAT in response to ARA, DHA and casein diets.*p < 0.05 vs. CON.



S1 Table . Dietary compositions.

Time stage	Groups	Protein (kcal%)	Carbohydrate (kcal%)	Fat (kcal%)	ARA (gm%)	DHA (gm%)	Extensively Hydrolyzed Casein (gm%)
4-12W	CON	18	72	10	0	0	0
	AD	18	72	10	0.116	0.083	0
	eHC	18	72	10	0	0	20
	CAD	17	72	10	0.116	0.083	20
12-24W	LFD-CON	18	72	10	0	0	0
	HFD-CON	18	36	46	0	0	0
	HFD-AD	18	36	46	0.116	0.083	0
	HFD-eHC	18	36	46	0	0	20
	CAD	18	36	46	0.116	0.083	20

S2 Table. Primers used in experiment.

Gene	Primer
UCP1-forward	GGCATTCAGAGGCAAATCAGCT
UCP1-reverse	CAATGAACACTGCCACACCTC
F4/80-forward	CTTTGGTATGGGCTTCCAGTC
F4/80-reverse	GCAAGGAGGACAGAGTTTATCGTG
IL6-forward	ACAACCACGGCCTTCCCTACTT
IL6-reverse	CACGATTTCCCAGAGAACATGTG
TNF-α-forward	ATGGCCTCCCTCTCATCAGT
TNF-α-reverse	TTTGCTACGACGTGGGCTAC
IL1β-forward	TCCAGGATGAGGACATGAGCAC
IL1β-reverse	GAACGTCACACACCAGCAGGTTA
PGC1α-forward	AGCCGTGACCACTGACAACGAG
PGC1α-reverse	GCTGCATGGTTCTGAGTGCTAAG
PRDM16-forward	CAGCACGGTGAAGCCATTC
PRDM16-reverse	GCGTGCATCCGCTTGTG
18S-forward	AGTCCCTGCCCTTTGTACACA
18S -reverse	CGATCCGAGGGCCTCACTA