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Supplemental information

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Figure S1-S7
Table S1

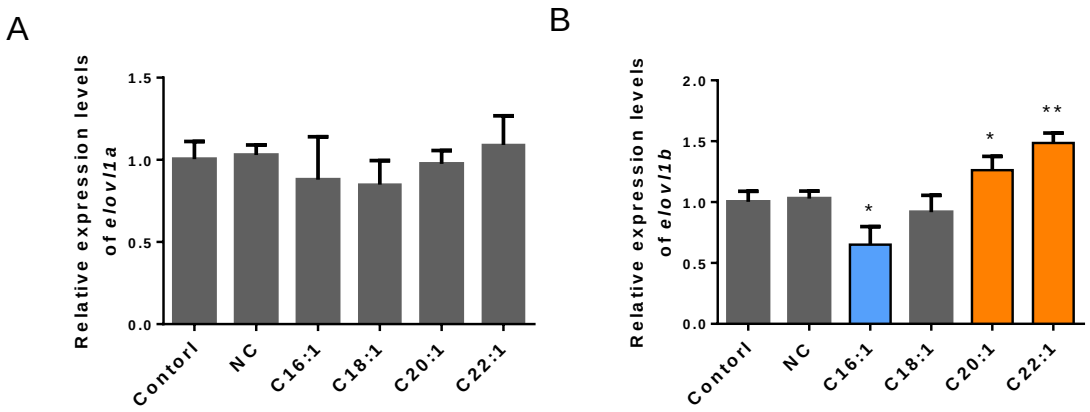

Figure S1. Expression levels of *elovl1a* (A) and *elovl1b* (B) in control and MUFA-treatment zebrafish liver (ZFL) cells at 28℃, related to Figure 1. The blue and orange color respectively meant significant decrease and increase in *elovl1b* expression level of the treated groups, compared with the control group. Data were given as means ± SD of 3 independent experiments. The statistical analyses were conducted by *T*-test. The asterisks labeled above the error bars indicated significant differences (*$p < 0.05$, **$p < 0.01$). MUFA, monounsaturated fatty acids; NC, negative control; elovl1, fatty acyl elongase 1.

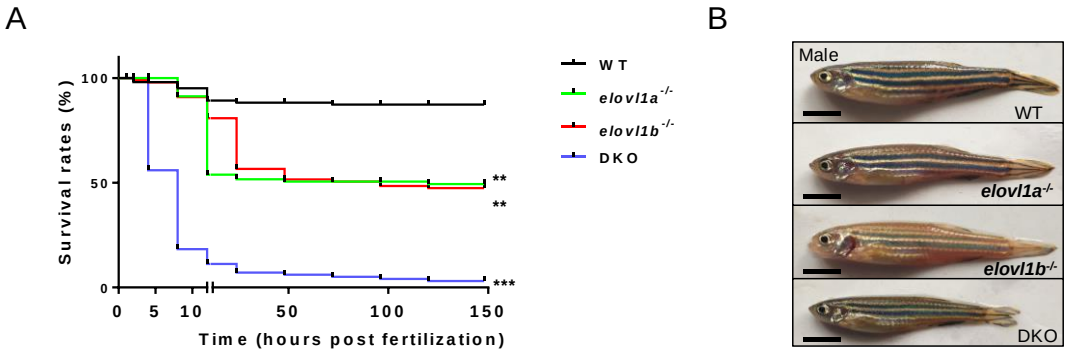

Figure S2. The early survival rates of WT, *elovl1a*$^{-/-}$, *elovl1b*$^{-/-}$ and DKO zebrafish (A) and pictures of these four kinds of zebrafish of two-month-old (B), related to Figure 2. Scale bar=5mm.WT, wild-type zebrafish; elovl1, fatty acyl elongase 1; *elovl1a*$^{-/-}$, *elovl1a* knockout zebrafish; *elovl1b*$^{-/-}$, *elovl1b* knockout zebrafish; DKO, double gene knockout zebrafish.

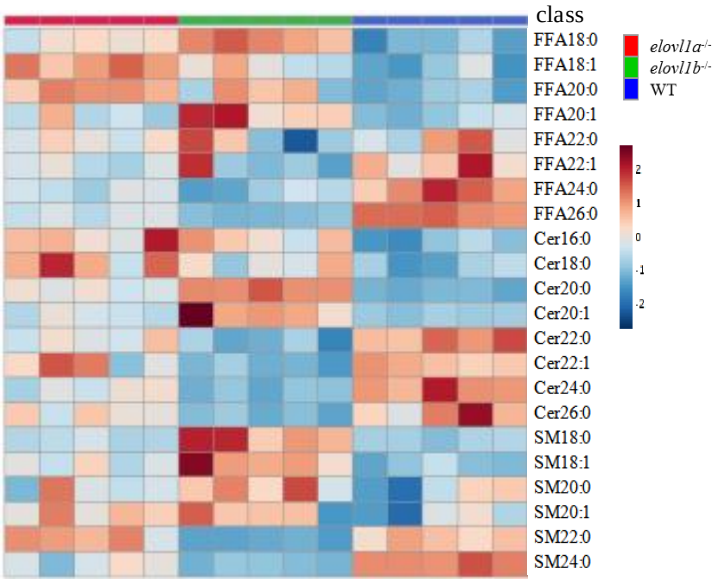

Figure S3. Heatmap of saturated and monounsaturated FFA, Cer and SM levels in livers of WT, *elovl1a*$^{-/-}$ and *elovl1b*$^{-/-}$ zebrafish, related to Figure 2. n=5.

WT, wild-type zebrafish; elovl1, fatty acyl elongase 1; *elovl1a*$^{-/-}$, *elovl1a* knockout zebrafish; *elovl1b*$^{-/-}$, *elovl1b* knockout zebrafish; FFA, free fatty acids; Cer, ceramide; SM, sphingomyelin.

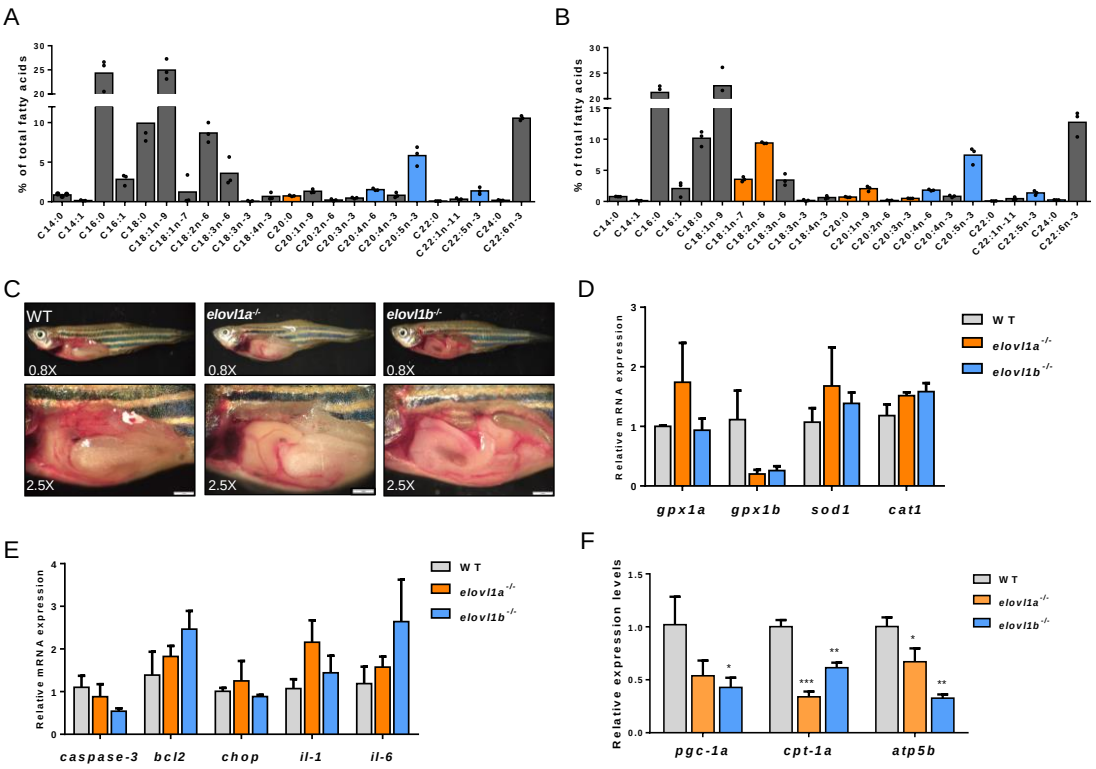

Figure S4. *elovl1* deletion impairs the cold resistance of zebrafish. (A and B) Fatty acid compositions in livers of *elovl1a*$^{-/-}$ (A) and *elovl1b*$^{-/-}$ (B) zebrafish under cold stress, related to Figure 3. The blue and orange color in (A) and (B) respectively meant significant decrease and increase in parameters of *elovl1a*$^{-/-}$/*elovl1b*$^{-/-}$ zebrafish, compared with WT zebrafish (p <0.05). (C) The liver lesions of WT, *elovl1a*$^{-/-}$ and *elovl1b*$^{-/-}$ zebrafish under cold stress, observed under light microscope. (D and E) The expression levels of antioxidant stress-related genes (D) and apoptosis-related genes and inflammation-related genes (E) in livers of WT, *elovl1a*$^{-/-}$ and *elovl1b*$^{-/-}$ zebrafish at 28℃. (F) The expression levels of β-oxidation-related genes in livers of WT, *elovl1a*$^{-/-}$ and *elovl1b*$^{-/-}$ zebrafish under cold stress.

Data were given as means ± SD of 3 independent experiments. The statistical analyses were conducted by *T*-test. The asterisks labeled above the error bars indicated significant differences (*p < 0.05, **p < 0.01, ***p < 0.001). WT, wild-type zebrafish; elovl1, fatty acyl elongase 1; *elovl1a*$^{-/-}$, *elovl1a* knockout zebrafish; *elovl1b*$^{-/-}$, *elovl1b* knockout zebrafish; *gpx1*, glutathione peroxidase 1; *sod1*, superoxide dismutase 1, soluble; *cat1*, catalase 1; *chop*, DNA-damage-inducible transcript 3; *bcl2*, BCL2 apoptosis regulator a; *il-1*, interleukin-1; *pgc-1a*, peroxisome proliferator-activated receptor-γ coactivator-1a; *cpt-1a*, carnitine palmitoyl transferase 1a; *atp5b*, ATP synthase 5b.

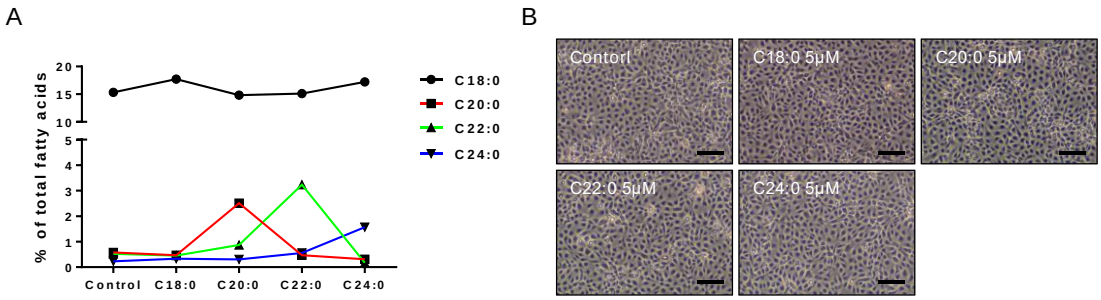

Figure S5. The effect of SFA treatment on zebrafish liver (ZFL) cells at 28℃, related to Figure 4. (A) The SFA compositions of ZFL cells incubated with C18-C24 SFA. (B) The proliferate status of ZFL cells with SFA treatment in 28℃, observed under light microscope. Scale bar=10μm. SFA, saturated fatty acids.

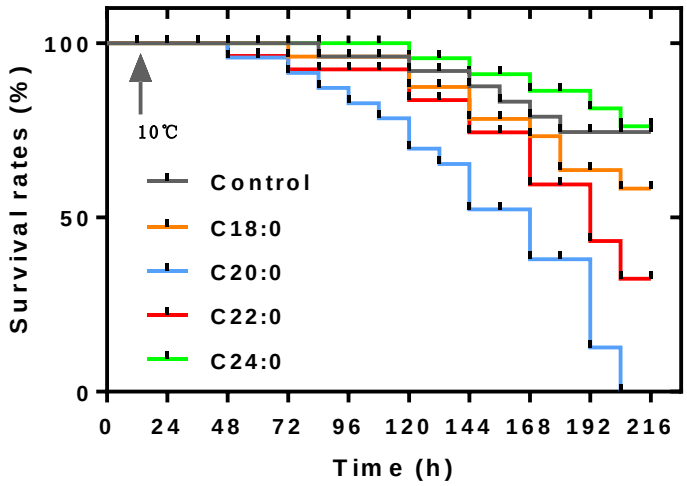

Figure S6. The survival rates of zebrafish during cold stress, after fed with different saturated fatty acid diets for 2 weeks, related to Figure 5.

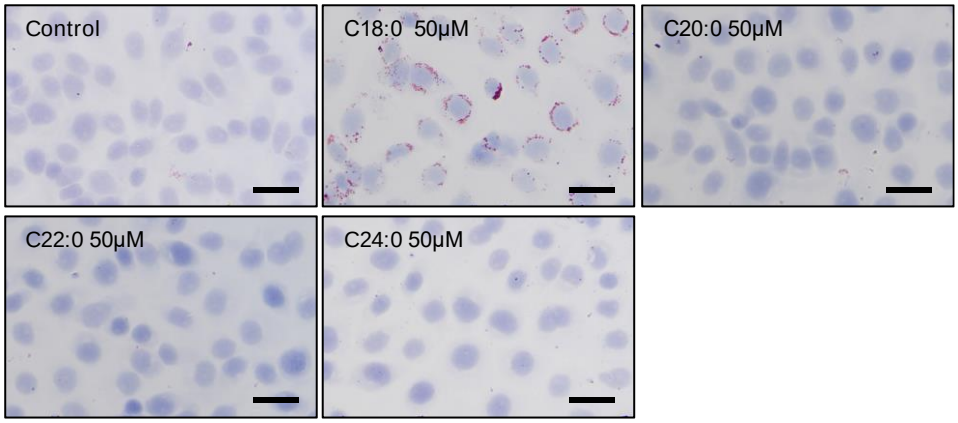

Figure S7. Oil red O staining of zebrafish liver (ZFL) cells incubated with C18-C24 saturated fatty acids, related to Figure 4. Scale bar=5μm.

Table S1. Primers used in this study, related to STAR Methods.

Symbol	Forward	Reverse	accession
Construction of knockout models			
elovl1a	AGCATCAATCCGACTTAT	TGGTTGAACTATCCCTTT	ID: 449816
elovl1b	ACCGTAAACCCTTTCAGC	AGATGGCAAGAGTTGCTT	ID: 406725
Real-time quantitative PCR			
β-actin	CACCACCACAGCCGAAAGAG	ACCGCAAGATTCCATACCCA	AF057040.1
18s rRNA	CGGCTACCACATCCAAGGAAGG	GCCCACTCCCGAGATCCAACTA	NR_145818.1
elovl1a	GAGACGTACGTTTGCGTCCA	ATGGGACTCTGCATCAACGG	NM_001005989.3
elovl1b	TCAGCTGAAAGAAGCCATGA	AAGGAATGATGGAAGATGTG	NM_213416.2
gpx1a	AGGCACAACAGTCAGGGATT	CAGGAACGCAAACAGAGGG	NM_001007281.2
gpx1b	GCGATGAGCCAATGCCGTTCA	GATGCCGCTGGTCAGGAATCTC	NM_001004634.2
sod1	GTCCGCACTTCAACCCTCA	TCCTCATTGCCACCCTTCC	NM_131294.1
cat1	CAAGGTCTGGTCCCATAAA	TGACTGGTAGTTGGAGGTAA	NM_130912.2
caspase-3	GATCGCAGGACAGGCATGAACC	CATCGCCGTGACTGAGCAACA	AB047003.1
chop	AGCGACTGATTGGTGCGATGAC	GGTGTTCTCCGTGGTTCGTTCT	NM_001082825.1
bcl2	TGTGCGTGGAAAGCGTCAACC	TCCGATGGTCACTCCTGCCAAG	AY695820.1
il-1	GGGCTCCTACCTGAACCACACA	TTGATGCGCTCCAGCTCCTCT	NM_001290418.1
il-6	CCTCAGTCCTGGTGAACGAC	GAACAGGATCGAGTGGACCG	NM_001261449.1
pgc-1a	ATAGAGGAGAGGCGAGTG	GTGTAGCGGTAGGTGATG	AY998087.2
cpt-1a	ATGAGGAGCACCAAAGAA	GTGGGAAAAGCGTAAAGA	NM_001044854.1
atp-5b	TCACAACCACCAAGAAGG	GGCTACATCATAATGCTCAG	NM_001024429.2
cers2a	GACGGTGTCACCTATGCCAA	TGGTCGCTCTTGGTTCCTTC	NM_153671.1
cers2b	GAGACGGAGAGTTGCACACA	GGCCAGTTCCAGCATGTAGT	XM_688576.7
cers4b	ACAGATTGAGATCAGCGGGC	CCCAGCAGGAAAATTGTGGC	XM_005163643.4
cers6	TCACACTAACGGGACCAACG	GCCGCGCTCAATCTAAAAGG	XM_688191.8

elovl1, fatty acyl elongase 1; *β-actin*, beta-actin; *18s rRNA*, 18S ribosomal RNA; *gpx1*, glutathione peroxidase 1; *sod1*, superoxide dismutase 1, soluble; *cat1*, catalase 1; *chop*, DNA-damage-inducible transcript 3; *bcl2*, BCL2 apoptosis regulator a; *il-1*, interleukin-1; *pgc-1a*, peroxisome proliferator-activated receptor gamma, coactivator 1 alpha; *cpt-1a*, carnitine palmitoyltransferase 1a; *atp-5b*, ATP synthase F1 subunit beta; cers, ceramide synthase.