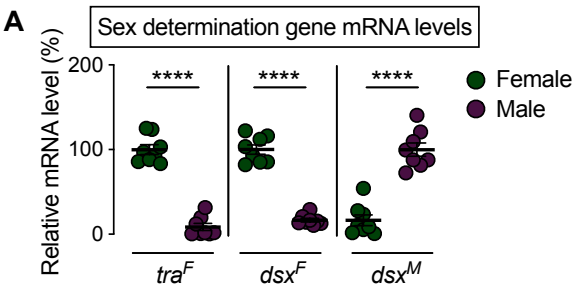

Fig. S1. Sex determination gene expression in sexed larvae. (A) mRNA levels of sex-specific isoforms of sex determination genes in male and female larvae (Student's *t* test). Females are expected to show expression of the female-specific isoforms of *transformer* (tra^F) and *doublesex* (dsx^F), whereas males are expected to show expression of the male-specific isoform of *doublesex* (dsx^M) . **** p<0.0001; error bars indicate SEM. *p*-values, samples sizes, and statistical tests are in Table S1.

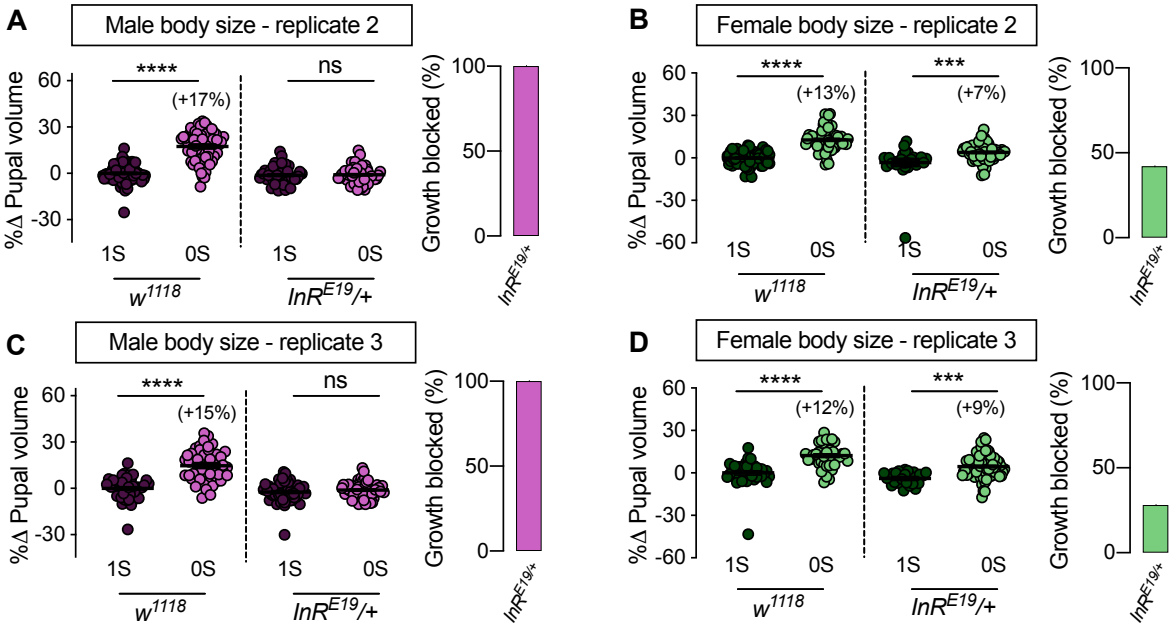

Fig. S2. Male-biased requirement for IIS in promoting the low sugar-induced increase in body size. (A) Pupal volume in w^{1118} and InR^{E19}/+ females cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 27-61. (B) Pupal volume in w^{1118} and InR^{E19}/+ males cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 48-74. (C) Pupal volume in w^{1118} and InR^{E19}/+ females cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 26-73. (D) Pupal volume in w^{1118} and InR^{E19}/+ males cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 45-51. To calculate sex:diet:genotype interactions three-way ANOVAs were used. *** p<0.001; **** p<0.0001; ns indicates not significant; error bars indicate SEM. To make percentage change pupal volume whole numbers, decimals <0.5 were rounded down, and decimals >0.5 were rounded up. *p*-values, samples sizes, and statistical tests are in Table S1.

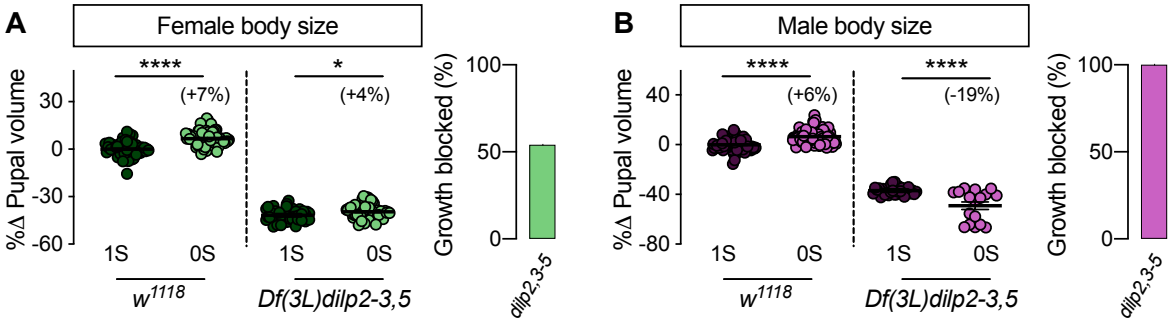

Fig. S3. Sex-biased requirement for *Drosophila* insulin-like peptides in promoting the low sugar-induced increase in body size. (A) Pupal volume in w^{1118} and *dilp2-3,5* females cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 50-69. (B) Pupal volume in w^{1118} and *dilp2-3,5* males cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 17-97. To calculate sex:diet:genotype interactions three-way ANOVAs were used. * p<0.05; **** p<0.0001; ns indicates not significant; error bars indicate SEM. To make percentage change pupal volume whole numbers, decimals <0.5 were rounded down, and decimals >0.5 were rounded up. *p*-values, samples sizes, and statistical tests are in Table S1.

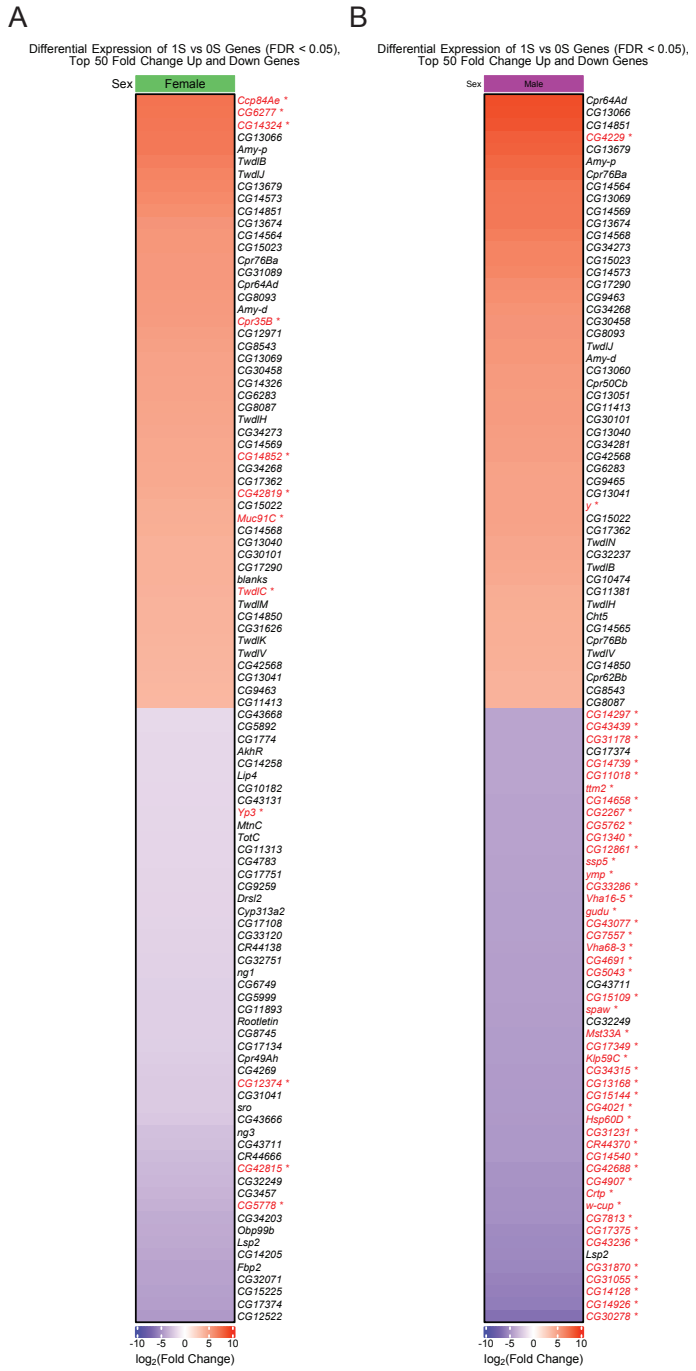

Fig. S4. Sex-specific changes in gene expression in response to a low sugar diet. (A) Top 50 differentially expressed upregulated and downregulated genes in females reared on a 0S diet. Differentially expressed genes unique to females are labelled in red. (B) Top 50 differentially expressed upregulated and downregulated genes in males reared on a 0S diet. Differentially expressed genes unique to males are labelled in red. A list of all differentially expressed genes is provided in Table S2.

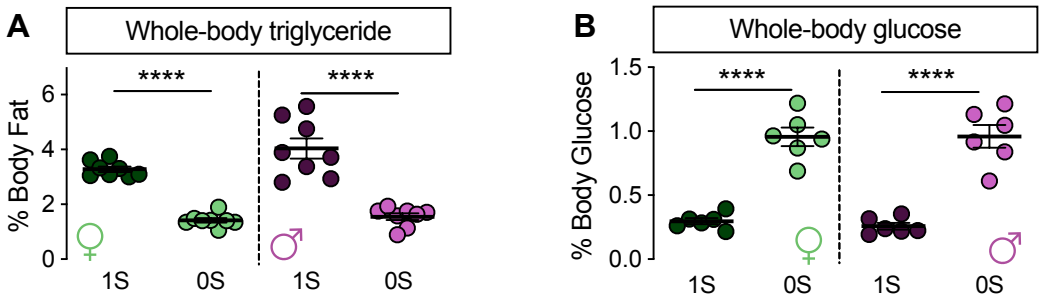

Fig. S5. Non-sex-specific changes to whole body triglyceride and glucose levels in larvae raised on a low-sugar diet. (A) Whole-body triglyceride levels in w^{1118} female and male larvae reared on 1S or 0S (Student's *t* test). n = 8 biological replicates. (B) Whole-body glucose levels in w^{1118} female and male larvae cultured on 1S or 0S (Student's *t* test). n = 6 biological replicates. **** p<0.0001; error bars indicate SEM. *p*-values, samples sizes, and statistical tests are in Table S1.

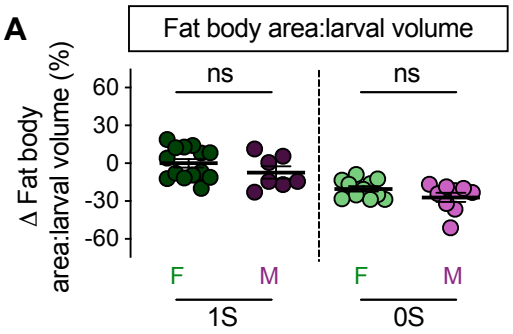

Fig. S6. Scaling between fat body area and body size does not differ between males and females reared on 0S or 1S. (A) The ratio of fat body area to larval volume is not different between females and males reared on either 1S or 0S (Student's *t* test). n = 7-14. ns indicates not significant; error bars indicate SEM. *p*-values, samples sizes, and statistical tests are in Table S1.

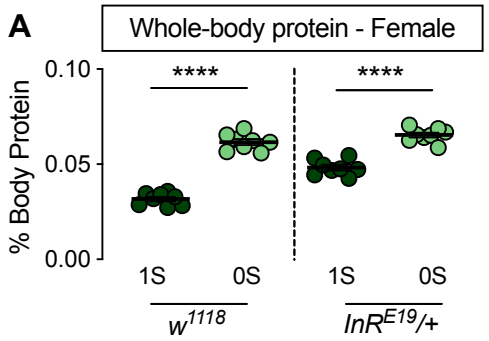

Fig. S7. Reduced IIS function does not block the female-specific increase in whole-body protein in 0S. (A) Whole-body protein levels in w^{1118} and InR^{E19}/+ female larvae reared on 1S or 0S. n = 8 biological replicates (two-way ANOVA followed by Tukey HSD test). **** p<0.0001; ns indicates not significant; error bars indicate SEM. *p*-values, samples sizes, and statistical tests are in Table S1.

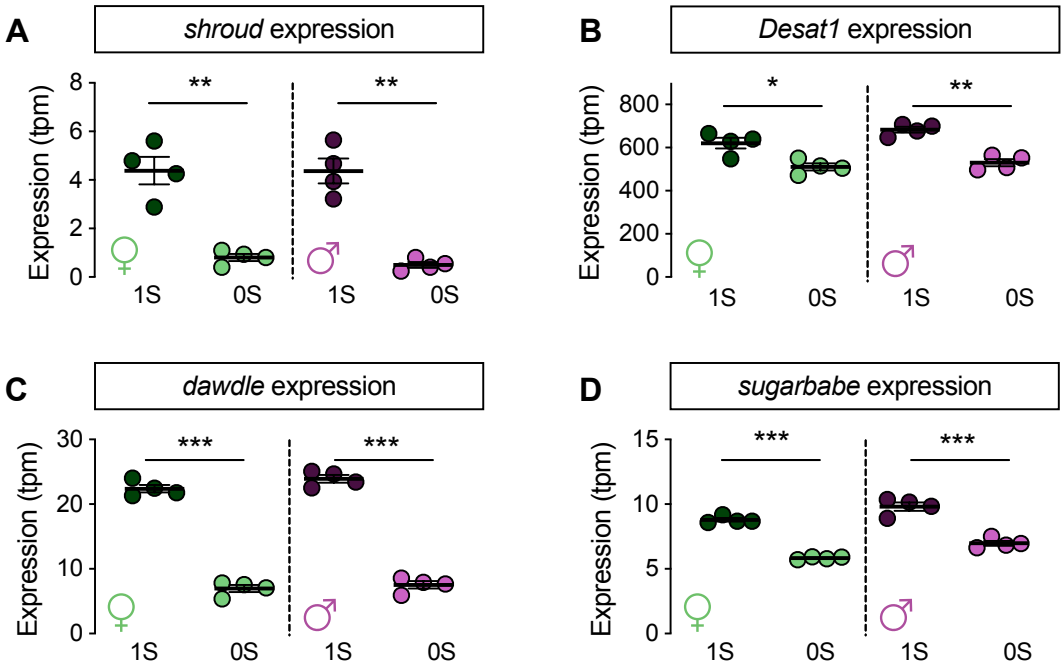

Fig. S8. Non-sex-specific changes to *Mondo*/*bigmax* target expression in larvae raised on a low-sugar diet. (A) Expression of *shroud* in females and males raised in 1S and 0S from RNA-seq data (Analyzed using adjusted *p* values calculated in DESeq2). (B) Expression of *Desat1* in females and males raised in 1S and 0S from RNA-seq data (Analyzed using adjusted *p* values calculated in DESeq2). (C) Expression of *dawdle* in females and males raised in 1S and 0S from RNA-seq data (Analyzed using adjusted *p* values calculated in DESeq2). (D) Expression of *sugarbabe* in females and males raised in 1S and 0S from RNA-seq data (Analyzed using adjusted *p* values calculated in DESeq2). ** p<0.01; *** p<0.001; ns indicates not significant; error bars indicate SEM. *p*-values, samples sizes, and statistical tests are in Table S1.

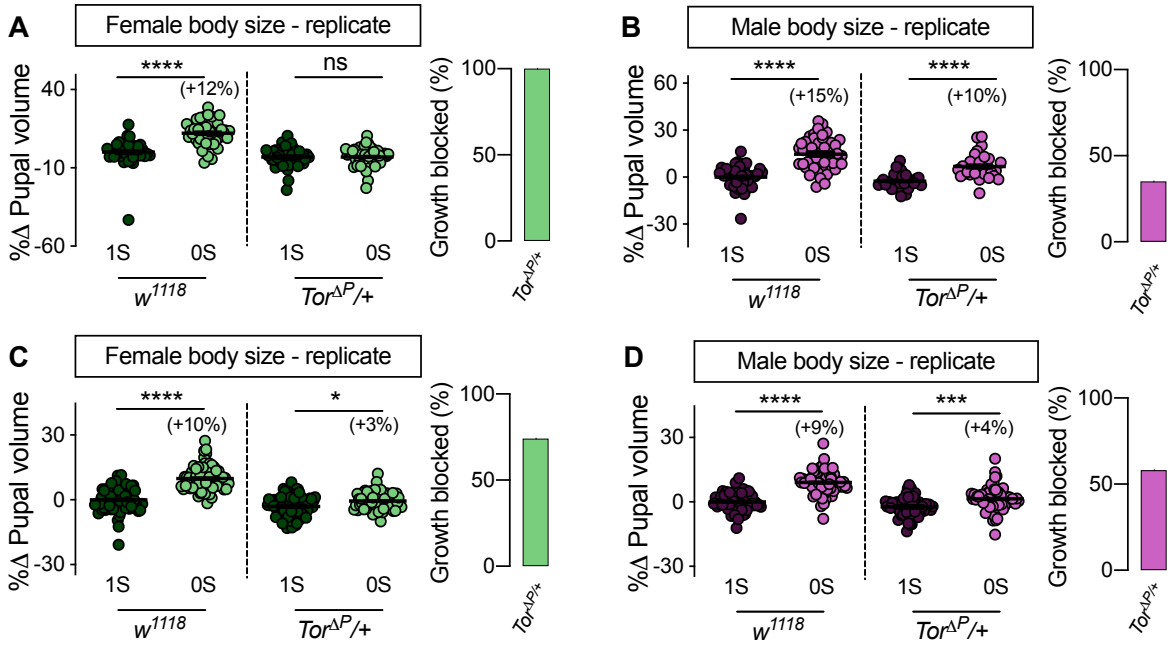

Fig. S9. Female-biased requirement for Tor in regulating the low sugar-induced increase in body size. (A) Pupal volume in w^{1118} and $Tor^{\Delta P}$/+ females cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 39-53. (B) Pupal volume in w^{1118} and $Tor^{\Delta P}$/+ males cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 29-49. (C) Pupal volume in w^{1118} and $Tor^{\Delta P}$/+ females cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 49-61. (D) Pupal volume in w^{1118} and $Tor^{\Delta P}$/+ males cultured on 1S or 0S (two-way ANOVA followed by Tukey HSD test). n = 56-74. To calculate sex:diet:genotype interactions three-way ANOVAs were used. *** p<0.001; **** p<0.0001; ns indicates not significant; error bars indicate SEM. To make percent change in pupal volume whole numbers, decimals <0.5 were rounded down, and decimals >0.5 were rounded up. *p*-values, samples sizes, and statistical tests are in Table S1.

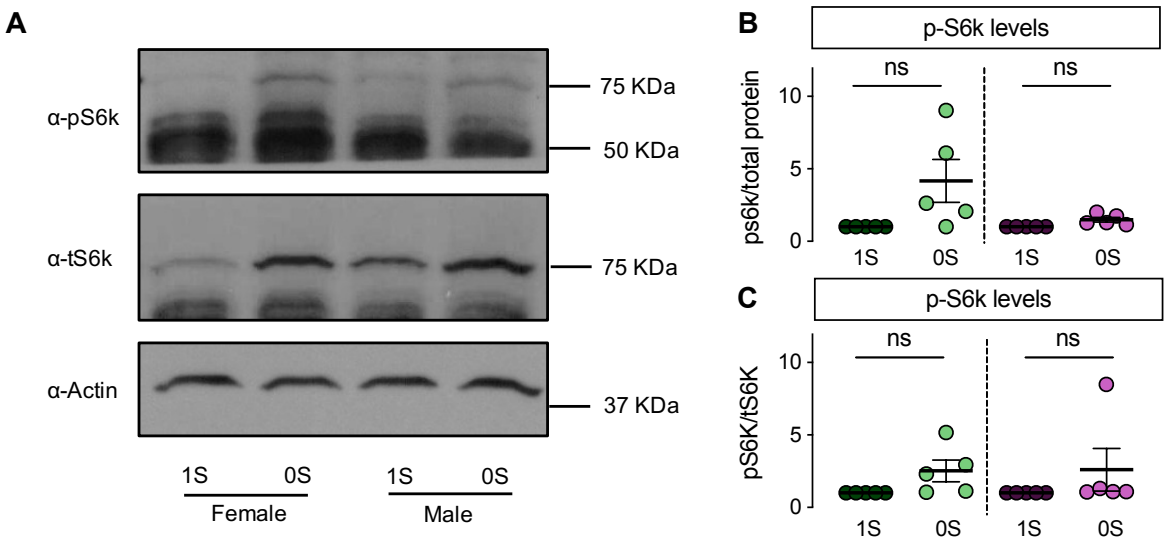

Fig. S10. Non-sex-specific trend toward increased phosphorylated S6k in a low sugar diet. (A) Representative blots of phospho-S6k, total S6K, and actin in male and female larvae raised in 1S or 0S diets. (B) Quantification of p-S6k/total protein levels in male and female larvae raised in 1S or 0S (Wilcoxon signed rank test). (C) Quantification of p-S6K/t-S6k levels in 1S or 0S (Wilcoxon signed rank test). ** $p<0.01$; ns indicates not significant; error bars indicate SEM. *p*-values, samples sizes, and statistical tests are in Table S1.

Table S1. Manuscript statistical analyses and *P*-values.

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Table S2. Differentially expressed genes from RNA-seq analysis of low-sugar diet-induced changes to gene expression.

Click here to download Table S2

Table S3. Raw values for all data collected in the manuscript.

Click here to download Table S3

Table S4. Recipes for all diets used in the manuscript.

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Table S5. Primer list for all qPCR in the manuscript.

Click here to download Table S5