**Supplementary Figure 1.**

**A-F)** Amount of cystine (nmol/mg of protein) in WT and *Ctns*-/- rats at different timepoints in various tissues. Boxed values indicate fold-change compared to WT at same timepoint. Two-way ANOVA performed, all data are plotted mean ± SEM. \*P<0.05, \*\*P<0.01, \*\*\*P<0.001. n = 5 WT and 6 *Ctns*-/- per group. **G)** Toluidine blue-stained kidney section from6-month-old *Ctns*-/- rat showing location of cystine crystals, visualised using polarised light 10x magnification. **H)** Toluidine blue-stained heart section from 3-month-old *Ctns*-/- rat, visualised using polarised light 20x magnification. **I)** Toluidine blue-stained liver section from 3-month-old *Ctns*-/- rat, visualised using polarised light 40x magnification. **J)** Toluidine blue-stained muscle section from 3-month-old *Ctns*-/- rat, visualised using polarised light 10x magnification.

**Supplementary Figure 2.**

**A)** Graph displaying creatinine clearance (ml/min) per 100g of body weight. Two-way ANOVA performed. \*P<0.05 **B, C)** Graph displaying weight per 100g of body weight of wild-type and *Ctns*-/- rat kidneys at 6-months of age in males and females. Unpaired t-test performed, all data are plotted mean ± SEM. \*\*\*P<0.001. n = 3 WT and 6 *Ctns*-/- per group. **D)** Representative image of fluorescent labelling with proximal tubule marker, Lrp2 in 17-month-old *Ctns*-/- rat. Scale bar 100 µm. **E-J)** Representative images of fluorescent labelling with nucleus marker Hoechst and cell death marker Apotag in WT and *Ctns*-/- rat at 12-months. Scale bar 100 µm. **K)** Graph displaying percentage of Apoptag positive cells relative to the number of nuclei in WT and *Ctns*-/- rat at different timepoints. Two-way ANOVA performed, all data are plotted mean ± SEM \*\*P<0.01, \*\*\*\*P<0.0001.

**Supplementary Figure 3.**

**A-F)** Graphs displaying quantification of total activity (cm), percentage of time spent in the inner area of the arena and number of rearing behaviours in 15 mins in both females and males. Two-way ANOVA performed, no significance observed. n= 13 *Ctns-/-* and 11 WT.Representative images of trabecular **(G-J)** and cortical **(K-N)** bone in tibias from female WT and *Ctns*-/- rats at 12 and 17 months of age. n= 14 *Ctns-/-* and 13 WT.

**Supplementary Figure 4.**

 **A, B)** Six-month-old *Ctns*-/- and WT whole thyroid at dissection. Scale bar 500 µm**. C)** H & E-stained thyroid section from6-month-old WTrat. 5 x magnification **C’)** 10 x magnification ofboxed area from C. **D)** H & E stained thyroid section from6-month-old *Ctns*-/- rat. 5 x magnification **D’)** 10 x magnification ofboxed area from D.Amount of **E)** triiodothyronine (T3) (nmol/L), **F)** thyroxine T4 (nmol/L) present in the plasma of WT and *Ctns*-/- rats. . Two-way ANOVA performed. \*P<0.05.