Transitioning from 2D to 3D culture workflows: Adipose tissue organoids resemble adult naïve tissues morphologically, molecularly, and functionally

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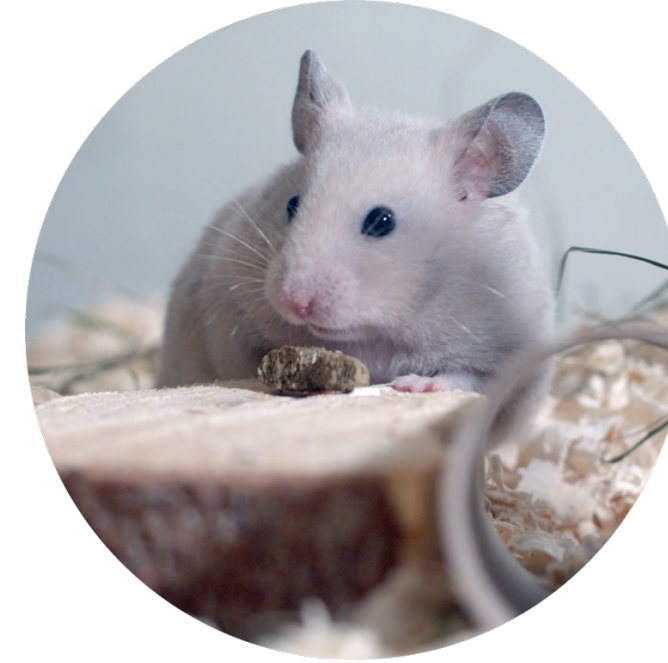
01. The Problem

More than 70% of adults in the U.S. are overweight or obese
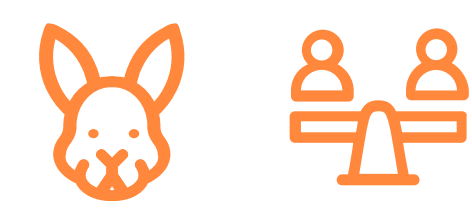
Risk factor for distinct pathophysiology

New anti-obesity drug testing has 99% failure

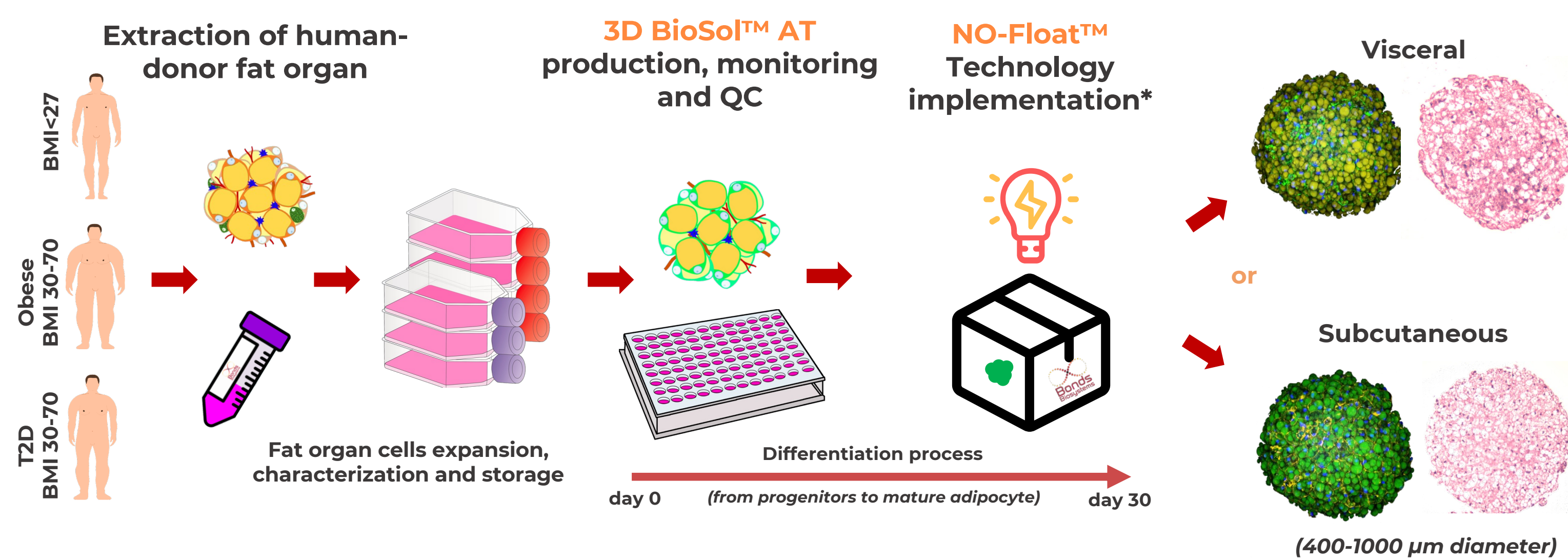High index of withdrawn due to safety concerns and lack of efficacy

Animal model has very limited correlation to human testing

In vitro 2D models are inaccurate and animals are poor predictors for humans

02. Our Pipeline

3D BioSol™ PLATFORM – Adipose Tissue

Figure 1: Schematics of the pipeline for the development of **3D BioSol™** Adipose Tissue (AT) organoids (Visceral and subcutaneous depots).
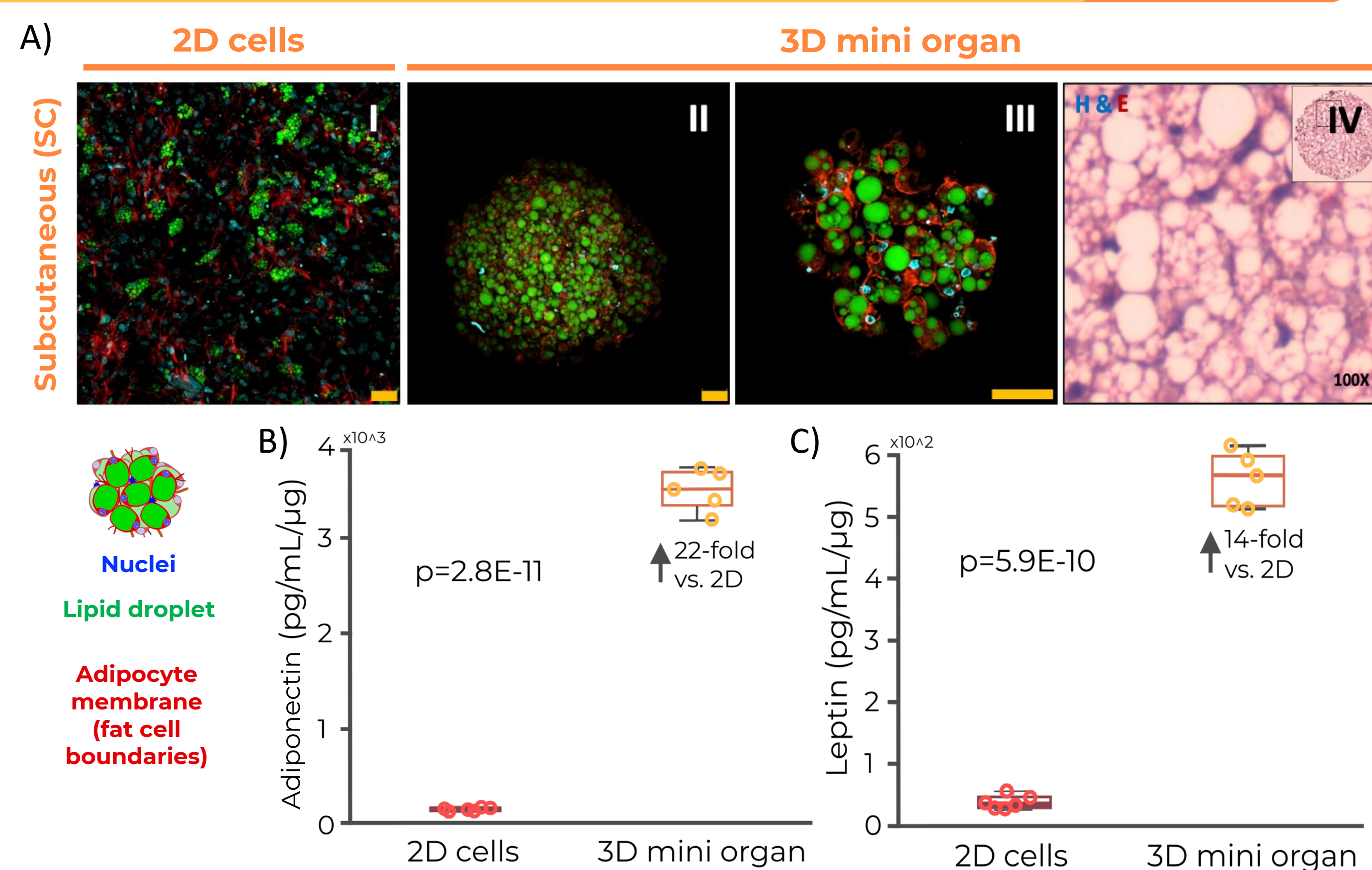
03. Solution Performance

Figure 2: *3D BioSol™ AT – subcutaneous.* Bonds Biosystems AT organoids display a significant amount of unilocular adipocytes and express up to 14 times more adipokines than its in-parallel differentiated 2D models. A I and II) Representative confocal immunofluorescence images at 10X magnification. Note visual difference in the size of the lipid droplets (green). Images are a maximum intensity projection representation from a 10 slices composition (5µm/slice). A III) Confocal immunofluorescence images at 20X magnification, unique slice. Scale bars: 50µm. B) Adiponectin and C) Leptin concentrations into the culture media. n= 5 independent organoids. Green: LipidTOX™. Red: phalloidin. Blue: DAPI.
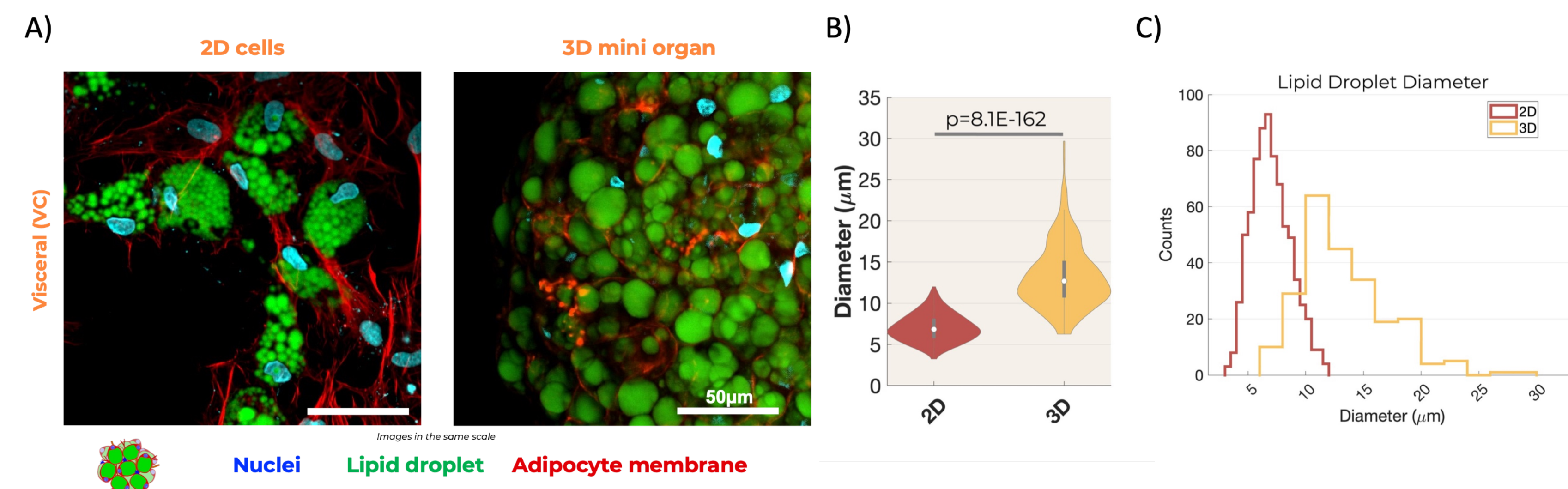

Figure 3: *3D BioSol™ AT – visceral.* Bonds Biosystems AT organoids display a significant amount of unilocular adipocytes and 3-4 times larger lipid droplets (in diameter) than its in-parallel differentiated 2D models. A) Representative confocal immunofluorescence images at 20X magnification. Note difference in the size of the lipid droplets (green). Images are a maximum intensity projection representation from a 10 slices composition (5µm/slice). B) Lipid droplet diameter length quantification. C) Populational distribution of the lipid droplet diameter length quantification. n= 8 independent organoids. Green: LipidTOX™. Red: phalloidin. Blue: DAPI.
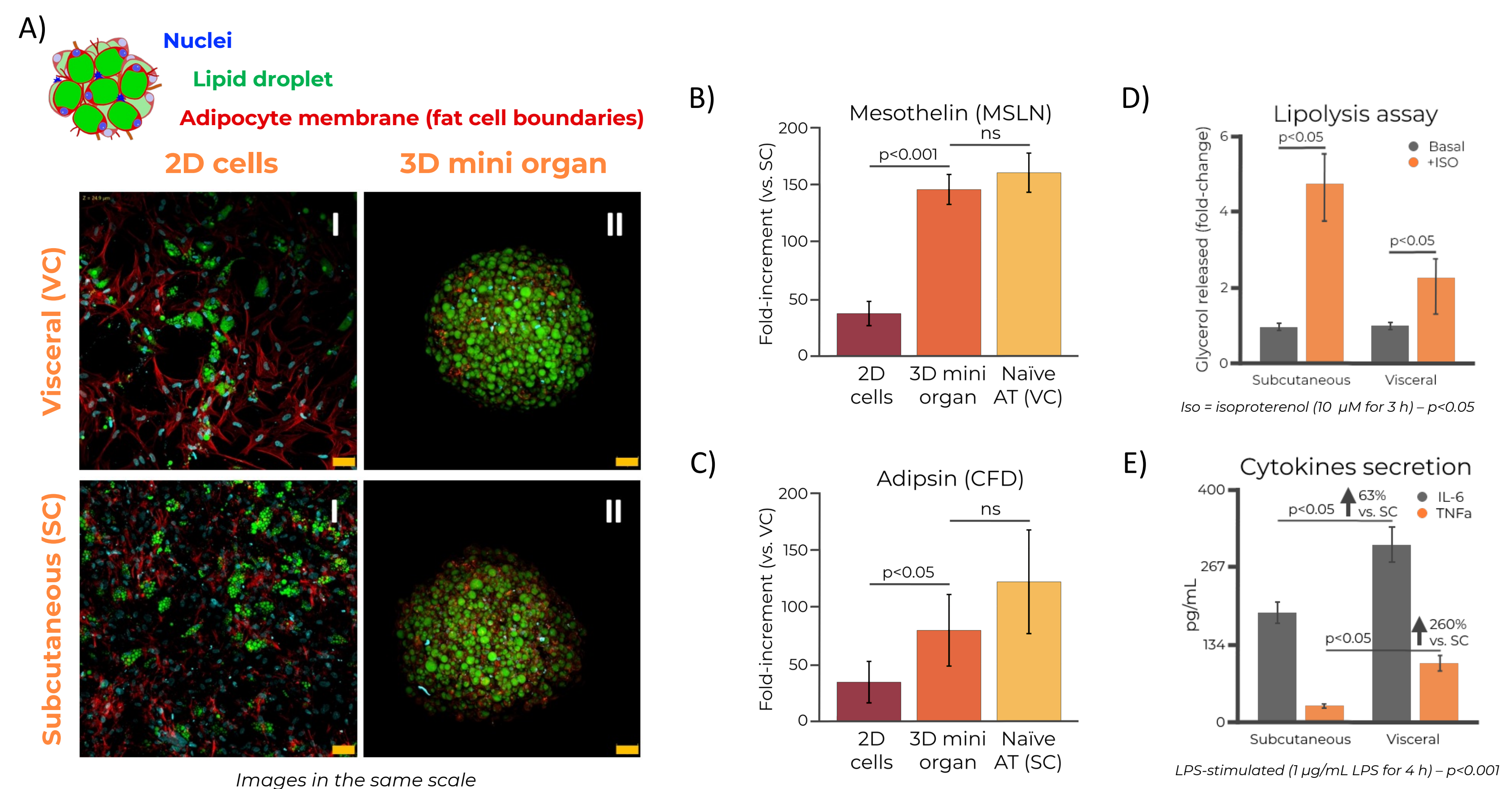

Figure 4: *3D BioSol™ AT – visceral vs. subcutaneous.* Bonds Biosystems AT organoids resemble tissue source molecular and functional characteristics and are superior compared with its in-parallel differentiated 2D models. A) Representative confocal immunofluorescence images at 10X magnification. Green: LipidTOX™. Red: phalloidin. Blue: DAPI. Disclosure: Subcutaneous I and II images are the same presented in Figure 2A. B) Visceral tissue, Mesothelin expression by RT-qPCR. Visceral organoids display similar MSLN expression to adult visceral Naïve AT (ns) and significantly higher expression compared with 2D cells (p=0.006). n= 5 organoids. C) Subcutaneous tissue, Adipsin expression by RT-qPCR. Subcutaneous organoids display similar CFD expression to adult subcutaneous Naïve AT (ns) and significantly higher expression compared with 2D cells (p=0.05). n= 3 organoids. D) Isoproterenol-induced lipolysis. E) Cytokines secretion to the culture media.

04. Conclusions

➢ 3D BioSol™ Adipose Tissue organoids display morphological features that closely resemble adult naïve adipose tissue.

➢ 3D BioSol™ Adipose Tissue organoids display molecular features that closely resemble adult naïve adipose tissue respecting AT depot source.

➢ 3D BioSol™ Adipose Tissue organoids display functional features that closely resemble adult naïve adipose tissue respecting AT depot source functional characteristics.

05. Our perspective

Using human in vitro 3D models, we envision creating platforms that can accelerate drug development and enhance new therapies' efficacy to bring new hopes to humankind, reducing costs and avoiding the excessive need for animal models.