OPPORTUNITY 3

SCOPE TRANSITIONAL

UNCERTAINTIES

Technology, Values

MEGATRENDS

Living with Robots and Automation

TRENDS

Advanced Computing
Biomaterials
Longevity & Vitality
Nanomedicine
Personalised Medicine

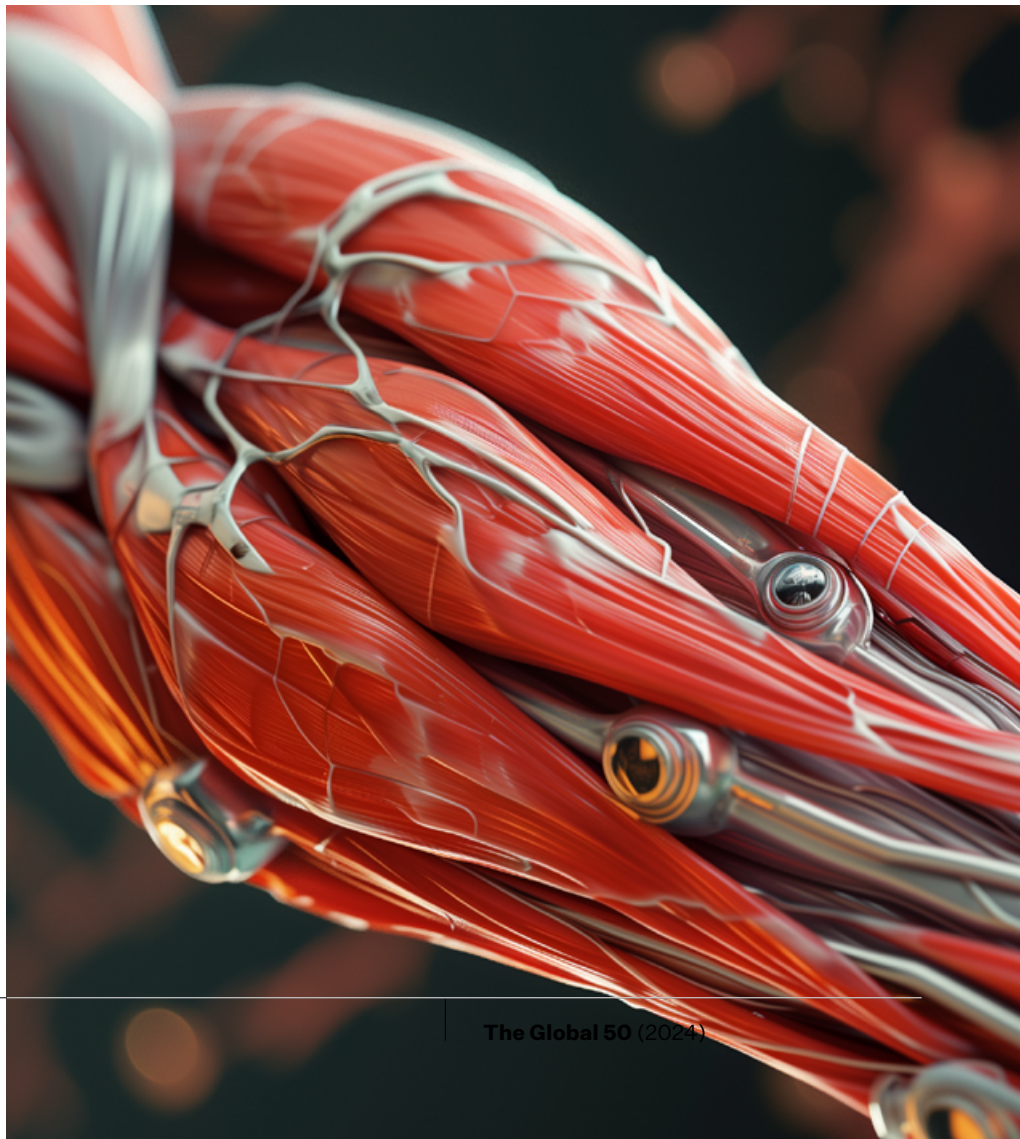
SECTORS IMPACTED

Agriculture & Food
Consumer Goods, Services & Retail
Data Science, AI & Machine Learning
Digital Goods & Services
Financial Services & Investment
Government Services
Health & Healthcare
Insurance & Reinsurance
Manufacturing
Materials & Biotechnology
Art, Media & Entertainment
Sports
Travel & Tourism

What if we stayed physically strong?

FIXING THE FLEX

Nanobots engineered for muscle repair and regeneration, prevent age-related muscle deterioration and provide targeted therapy for musculoskeletal pain and disease.



WHY IT MATTERS TODAY

As pain often persists into adulthood, musculoskeletal pain in young people can also impact on

future health, education, and employment

Skeletal muscle composition varies by age, gender, race, and activity levels, making up

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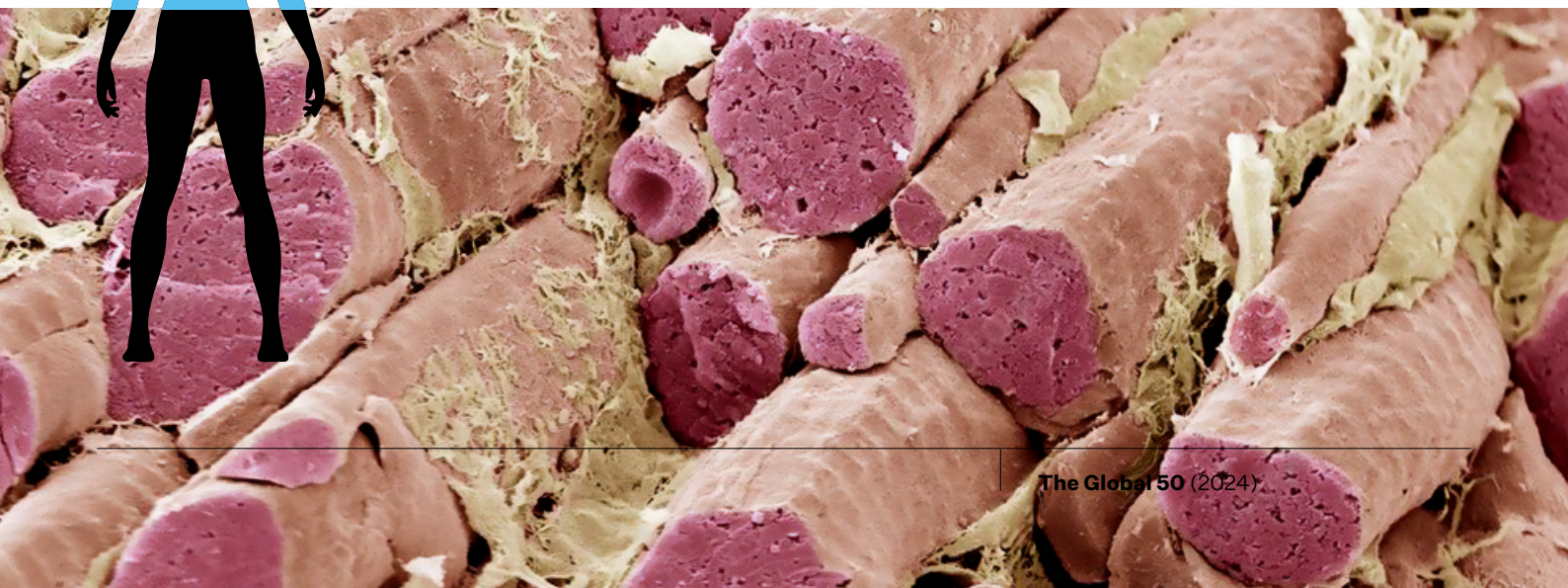
Skeletal muscle composition varies by age, gender, race, and activity levels, making up 40%–50% of body mass.[221] Musculoskeletal pain affects people of any age.[222] Lower back pain alone afflicts 619 million people (nearly 10% of the world's population), a number expected to reach 843 million by 2050.[223]

Persistent musculoskeletal pain affects 40%–60% of older adults, often leading to disability, falls, and cognitive issues, with treatment costs in 2019 estimated to be $300 billion in just the United States.[224] By 2050, the number of people in the world aged 60 and over is expected to double.[225] Musculoskeletal pain will continue to be a key area of concern because, as well as reduced mobility and higher levels of frailty, it can cause depression and dementia among the elderly.[226]

Musculoskeletal pain is also experienced by young people. Associated with more sedentary lifestyles in adolescents,[227] musculoskeletal pain can lead to obesity, cardiovascular disease,[228] psychological impacts, and pain anxiety.[229] As pain often persists into adulthood, it can also impact on future health, education, and employment.[230] A 2007 study in the United Kingdom indicated that 22% of children aged 11–14 experienced lower back pain,[231] and in a 2019 study in Poland nearly 56% of 10- to 19-year-old children experienced lower back pain and 74% back pain in general.[232] Data from 2019 in Portugal[233] showed that prevalence increased with age (aged 9 to 19)[234] and common causes included heavy lifting, carrying backpacks, and prolonged sitting (70.7%, 67.4%, 67.8%).[235]

While real-world clinical applications of nanobots have been limited, they have been piloted in vaccine development[236] and cancer treatment and diagnoses.[237] Nanobots are tiny robots of nanoscale size (100nm or less)[238] that are programmed to convert energy into mechanical forces to fulfil a specific task. As part of nanomedicine, nanobots can be used for diagnoses and treatment.[239]



OPPORTUNITY

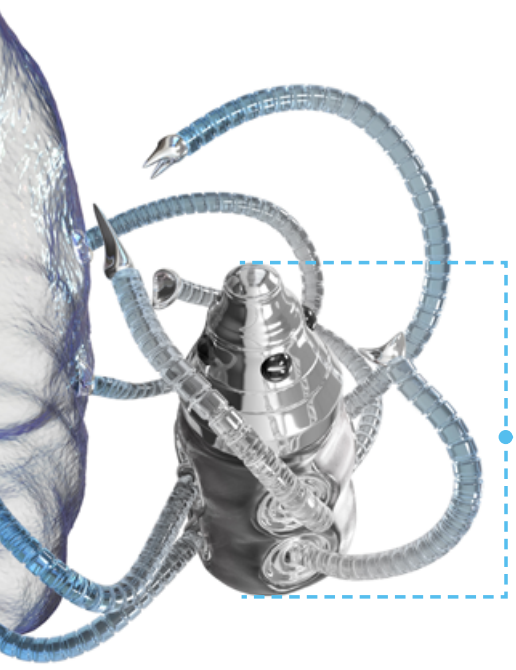
Nanobots are engineered to interact with cells for muscle restoration, repair, or regeneration of muscle damaged or lost because of injury or age-related deterioration. This may include electrical muscle stimulation,[240] muscle stem cell activation,[241] conductive hydrogels,[242] and, although with mixed results, targeted delivery of platelet-rich plasma[243] or platelet-rich fibrin.[244] With further advances in genomics, personalised medicine, and nanotechnology-based therapies,[245] nanobots can one day be used to prevent muscle deterioration and to slow ageing in the first place, preserving life-long mobility and strength, making sarcopenia[246] – a reduction in muscle mass and functionality – a thing of the past.

BENEFITS

Preserving and restoring muscle strength contributes to overall levels of fitness and well-being. Across all age groups, nanobots can help prevent disability and loss of quality of life, potential earnings, and productivity.

RISKS

Nanobots meant to repair or preserve muscles may inadvertently affect other organs and biological systems, increasing, for example, cardiovascular risks. Lower efficacy might be due to lack of understanding of the interaction of nanoparticles with cells, considering factors like age and gender.



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