Effect of swimming on the muscle fibre type transitions in skeletal muscles of rats with colon carcinoma

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Muscle fibre types and myosin heavy chain (MyHC) isoforms in rat

slow-twitch (red) fibres:	type 1	MyHC-1
fast-twitch (white) fibres:	type 2a	MyHC-2a
	type 2x	MyHC-2x
	type 2b	MyHC-2b

hybrid fibres (two or more MyHC isoforms):

type 1/2a, 2ax, 2xb

1/2x 1/2ax 1/2ab 1/2b

2axb 2ab

Muscle plasticity

switch in the MyHC genes expression

↓

fibre type transitions

1↔1/2a↔2a↔2ax↔2x↔2xb↔2b

Muscle plasticity

- **hyperthyroidism, reduced weight- bearing and neuromuscular activity:**

  slow to fast fibre type transition (S→F)

- **hypothyroidism, cronic over-loading, increased neuromuscular activity:**

  fast to slow fibre type transition (F→S)

Animals and experimental protocol

Wistar rats (4 week-old)

non-swimmers (NS, n = 6)

swimmers (S, n = 6)

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1. week 15 min/5 days
2. week 30 min/5 days
3 - 8. week + 10 min/week

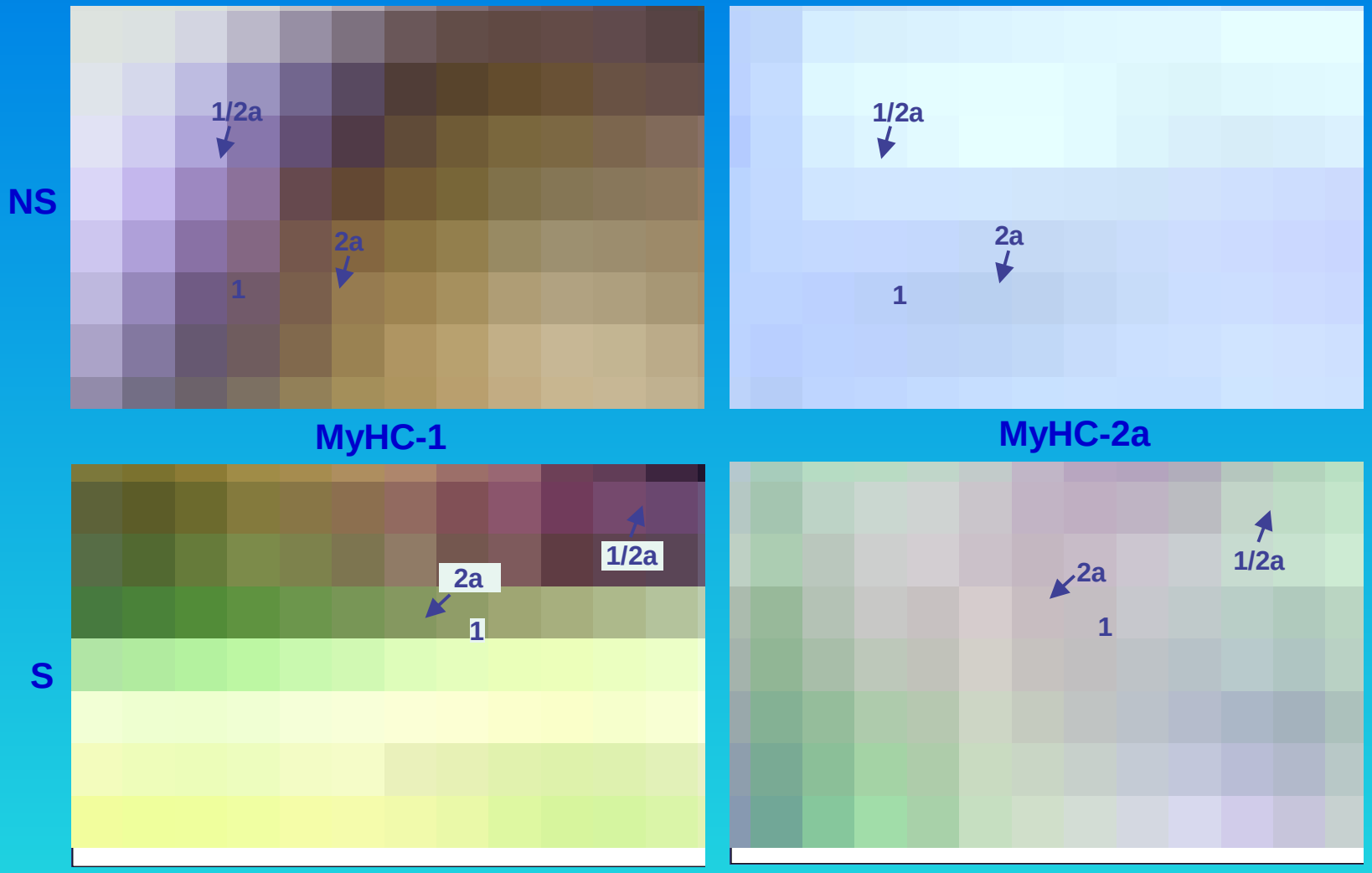
Muscles

- soleus (SOL)
- extensor digitorum longus (EDL)
- gastrocnemius medialis:
  - deep red part (GMr)
  - superficial white part (GMw)
- gastrocnemius lateralis:
  - deep red part (GLr)
  - superficial white part (GLw)

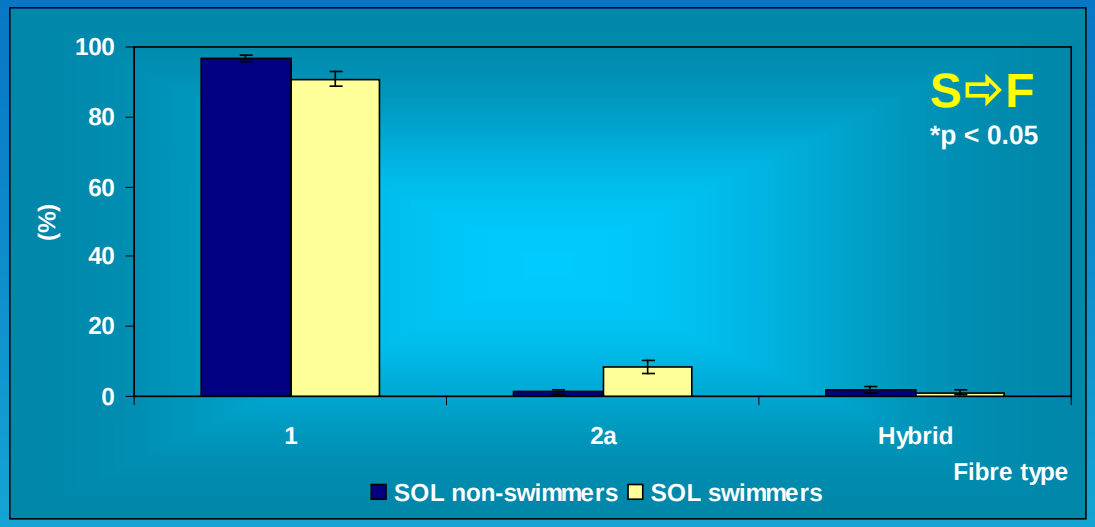
MyHC isoforms detection

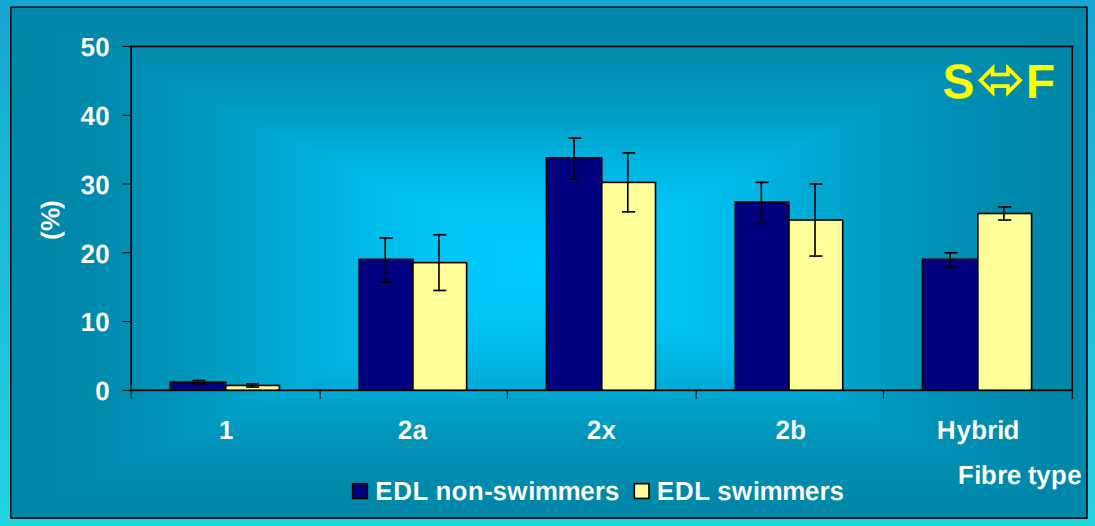
- immunohistochemistry with monoclonal antibodies specific to MyHC isoforms (Schiaffino S, et al., 1986; Lucas CA, et al., 2000)
- fibre type composition (N_N, %) of muscles assessed with computer-assisted system for image analysis (Karen P, et al., 2009)

Fibre types (1, 1/2a, 2a) in SOL of non-swimmers (NS) and swimmers (S)

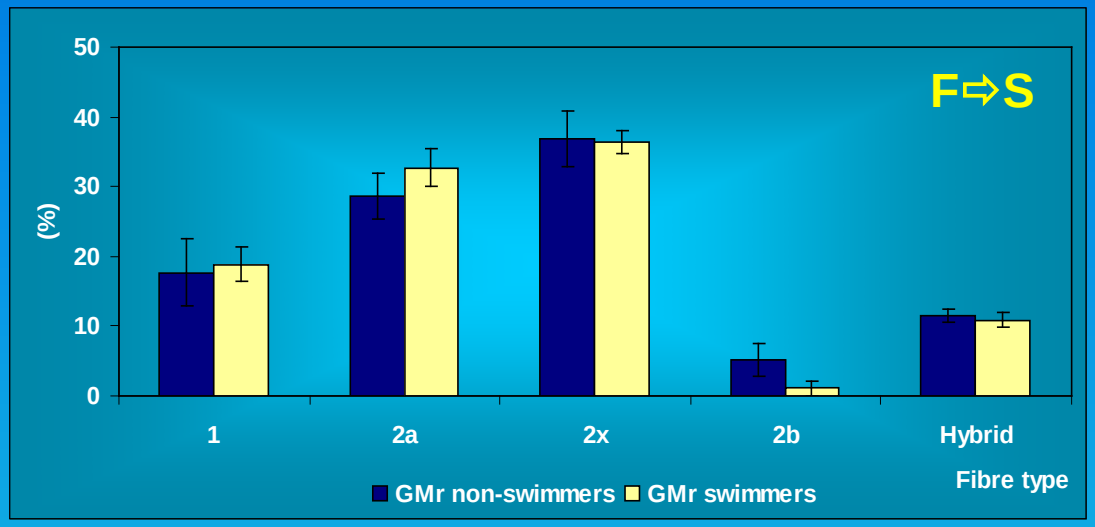


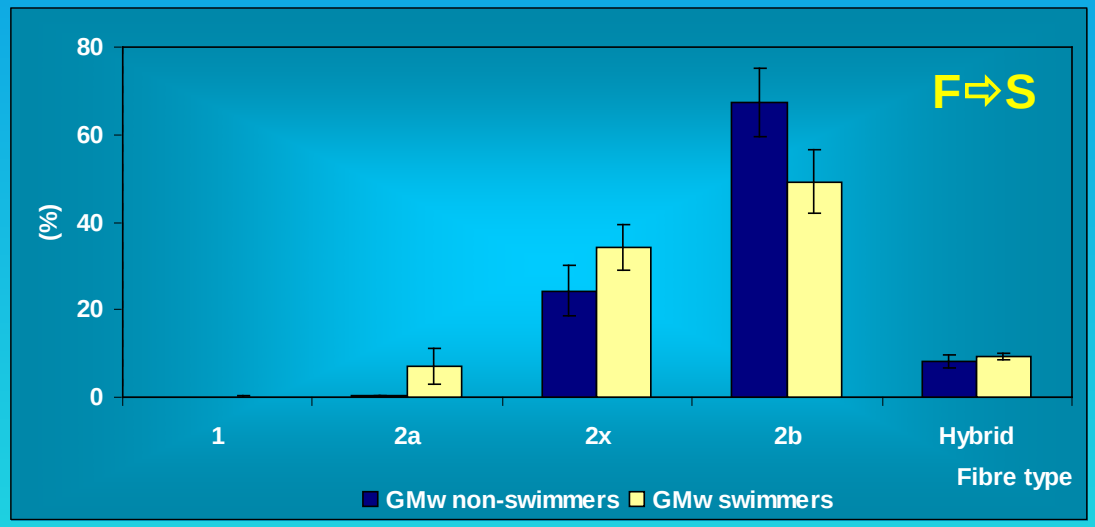
Fibre type composition of SOL and EDL



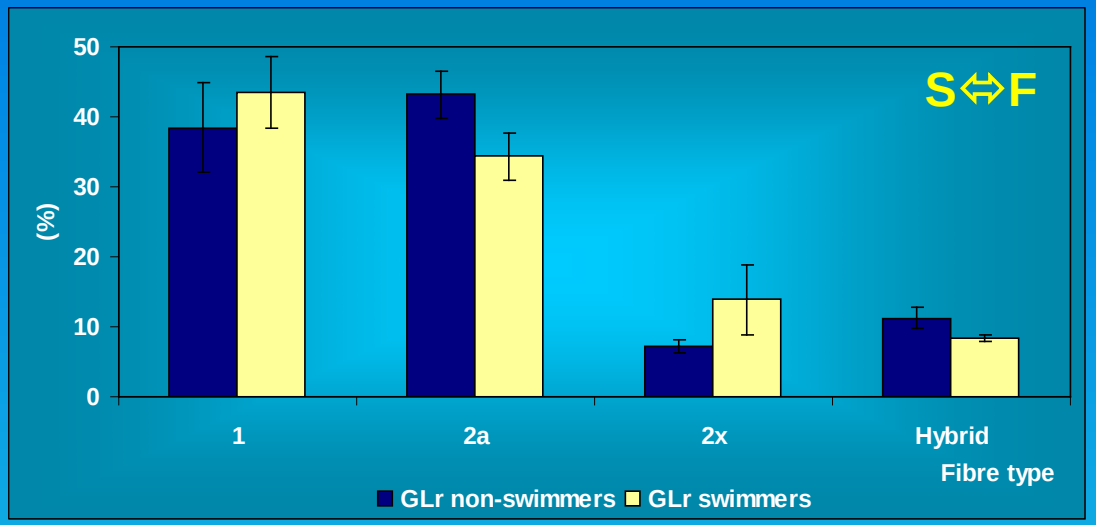


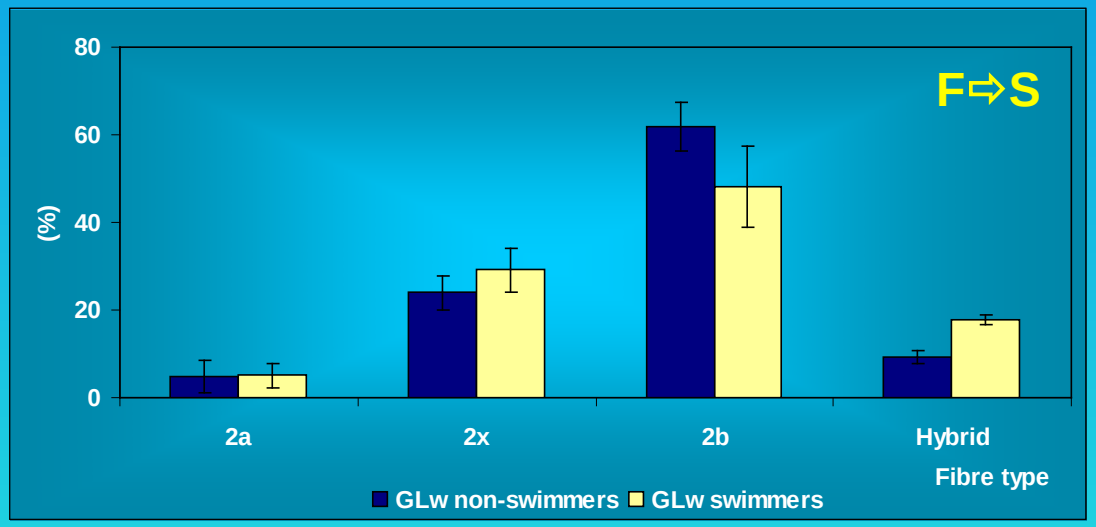
Fibre type composition of GMr and GMw





Fibre type composition of GLr and GLw





Conclusions

1. 21-week swimming induced only moderate fibre type transitions except of SOL muscle.

2. The direction and the extent of fibre type transitions was probably related to the genetically determined fibre type composition of muscles and to their role in swimming.

Muscle plasticity

switch in the MyHC genes expression

↓

fibre type transitions

1↔1/2a↔2a↔2ax↔2x↔2xb↔2b

1/2x 1/2ax 1/2ab 1/2b

2axb 2ab

Muscle plasticity

- **hyperthyroidism, unloading, reduced weight-bearing and neuromuscular activity:**

  slow to fast fibre type transition (S→F)

- **hypothyroidism, cronic over-loading, increased neuromuscular activity:**

  fast to slow fibre type transition (F→S)