1. Introduction

Exercise is health promoting in many aspects of human physiology by its ability to prevent and treat various diseases. However, society face the problem that exercise is the "pill" only a few people want to/can take. Hence, increasing levels of physical inactivity contribute significantly to the increased prevalence of several metabolic diseases including Type 2 Diabetes (T2D) (Booth *et al.*, 2012). T2D is characterized by an inability to maintain glucose homeostasis due to insulin deficiency and insulin resistance in several tissues including skeletal muscle (DeFronzo, 1988). Skeletal muscle is one of the largest tissues in the human body and in response to insulin, glucose uptake of the muscle increases. Hence, skeletal muscle serves as the predominant site for insulin-stimulated glucose disposal and is therefore essential for maintaining glucose homeostasis (DeFronzo *et al.*, 1981). Skeletal muscle has a remarkable ability to remodel its protein composition in response to use (e.g. physical activity) and disuse (e.g. physical inactivity) (Snijders *et al.*, 2015) One of the well-known beneficial effects of regular exercise training (repeated bouts of exercise) is enhanced insulin action in skeletal muscle (Dela *et al.*, 1992, 1995; Frøsig *et al.*, 2007*a*) leading to improved whole-body glucose homeostasis (Ruderman *et al.*, 1979; Saltin *et al.*, 1979; Dela *et al.*, 1992, 1995; Frøsig *et al.*, 2007*a*). In the 1920s, it was first demonstrated that also a single bout of exercise could improve insulin action. This was observed in insulin-dependent diabetics experiencing hypoglycemia hours into the recovery from a single bout of exercise unless increased amounts of glucose were ingested or lower amounts of insulin were injected (Lawrence, 1926). The improved insulin action was later shown to be confined to skeletal muscle and only the prior exercised muscle (Richter *et al.*, 1982; Wallberg-Henriksson *et al.*, 1988; Cartee *et al.*, 1989; Richter *et al.*, 1989; Cartee & Holloszy, 1990; Annuzzi *et al.*, 1991; Wojtaszewski *et al.*, 1997, 2000*a*; Frøsig *et al.*, 2007*b*; Treebak *et al.*, 2009)
Although it is well established that a single bout of exercise increases insulin action in the prior exercised muscle our understanding of the underlying mechanisms is still limited. Elucidating these mechanisms could serve as an important tool in the development of therapeutics for the prevention and treatment of insulin resistance and T2D. Furthermore, the magnitude of the response to a single bout of exercise on insulin action in muscle as well as whole-body glucose metabolism is not fully characterized. To investigate this as well as the molecular mechanisms involved, the response to a single bout of exercise on insulin action was explored under different conditions of the muscle in the studies conducted during the thesis work. In the present thesis, current literature on the effects of a single bout of exercise on insulin action will be reviewed and results obtained in the studies will be discussed accordingly. The first section of the thesis will describe insulin-stimulated glucose uptake in skeletal muscle. The two next sections will discuss mechanisms affecting the response to a single

bout of exercise on muscle and whole body insulin action, while the last section will discuss insulin action at a muscle fiber type-specific level.