

BRIEF REPORT

Semaglutide as a therapeutic option for elderly patients with type 2 diabetes: Pooled analysis of the SUSTAIN 1-5 trials

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The efficacy and safety of semaglutide vs comparators in non-elderly (<65 years) and elderly (≥65 years) patients with type 2 diabetes (T2D) across the SUSTAIN 1-5 trials were evaluated. Patients were randomized to once-weekly subcutaneous semaglutide (0.5 or 1.0 mg) vs placebo, sitagliptin, exenatide or insulin. The primary objective was change in HbA1c and secondary objectives were changes in body weight and safety. Mean HbA1c decreased from baseline by 1.2%-1.5% and 1.5%-1.9% vs 0%-0.9% (non-elderly, n = 3045) and by 1.3%-1.5% and 1.2%-1.8% vs 0.2%-1.0% (elderly, n = 854) with semaglutide 0.5 and 1.0 mg vs comparators. Similar reductions from baseline in mean body weight with semaglutide occurred in both age groups. Similar proportions of patients experienced adverse events; premature treatment discontinuations were higher in elderly vs non-elderly patients. No increased risk of severe or blood glucose-confirmed hypoglycaemia was seen with semaglutide vs comparators between age groups. Semaglutide had a comparable efficacy and safety profile in non-elderly and elderly patients across the SUSTAIN 1-5 trials, making it an effective treatment option for elderly patients with T2D.

KEYWORDS

antidiabetic drug, GLP-1 analogue, glycaemic control, incretin therapy, type 2 diabetes

1 | INTRODUCTION

The incidence of type 2 diabetes (T2D) increases with age, reaching a peak at 65-69 years for men and 75-79 years for women.¹ It is therefore important that safe and effective treatments are available for elderly patients with T2D.

When considering diabetes treatment for older patients, frailty and common comorbidities including cardiovascular (CV) disease, renal impairment and cognitive dysfunction should be taken into consideration.² Certain drugs must be used with caution because of their associated risks: lactic acidosis with metformin in patients with renal impairment; hypoglycaemia with sulphonylureas (SUs) and insulin; and bone fractures and fluid retention with thiazolidinediones.² Elderly patients with T2D are often on multiple medications; up to 57.1% take at least five drugs with potential drug interactions.³ As elderly patients with T2D are at an increased risk of

hypoglycaemia, less stringent glycaemic targets are recommended (e.g. HbA1c 7.5-8.5% vs <7.0% in the general population).^{4,5} The risk of iatrogenic hypoglycaemia and adverse events (AEs) should be balanced against the benefits of glycaemic control.²

Incretin-based therapies (glucagon-like peptide-1 receptor agonists [GLP-1RAs] and dipeptidyl peptidase-4 [DPP-4] inhibitors) lower glucose levels by increasing glucose-dependent insulin secretion in response to nutrient intake, without increasing hypoglycaemia.⁶ Head-to-head trials have shown that GLP-1RAs provide more effective glycaemic control (HbA1c, fasting plasma glucose [FPG] and postprandial glucose reductions) than DPP-4 inhibitors.⁶ Several studies have assessed the use of incretin-based therapies in the elderly (Appendix S1), with findings typically showing no major differences in their efficacy or tolerability in older vs younger patients.

Semaglutide is a human GLP-1 analogue for once-weekly treatment of T2D. Across global phase 3 trials, SUSTAIN 1-5, semaglutide showed reductions in HbA1c and body weight (BW), as monotherapy and combined with oral antidiabetic drugs (OADs) or insulin. There were no unexpected safety or tolerability issues.⁷⁻¹¹

This pooled analysis is the first comprehensive analysis of the SUSTAIN 1-5 efficacy trials that aims to characterize the efficacy and safety of semaglutide vs comparators in elderly and non-elderly patients.

2 | METHODS

The designs of the phase 3 SUSTAIN 1-5 trials have been previously described.⁷⁻¹¹ The trials are registered with ClinicalTrials.gov. Trial design and inclusion/exclusion criteria are summarized in Table S1.

In SUSTAIN 1-5, 3045 patients with T2D were randomized to once-weekly subcutaneous semaglutide 0.5, 1.0 mg (1.0 mg only in SUSTAIN 3) or comparators (Appendix S1).

The *post hoc* analysis assessed outcomes in non-elderly (<65 years) and elderly (≥65 years) patients, pooled by age group (Appendix S1). The primary objective was to assess the effect of semaglutide on glycaemic control (change in HbA1c in patients with T2D) at the end of treatment (EOT).

3 | RESULTS

The baseline characteristics of non-elderly and elderly patients across SUSTAIN 1-5 are summarized in Table 1.

3.1 | Glycaemic control

Semaglutide reduced mean HbA1c from baseline to EOT in both age groups vs all comparators (Figure 1A). With semaglutide 0.5 mg, HbA1c reductions ranged from -1.2% to -1.5% (non-elderly patients) and -1.3% to -1.5% (elderly patients); with semaglutide 1.0 mg, HbA1c reductions ranged from -1.5% to -1.9% (non-elderly) and -1.2% to -1.8% (elderly). For comparators, the ranges were 0.0% to -0.9% (non-elderly) and -0.2% to -1.0% (elderly). In non-elderly patients, the estimated treatment difference (ETD) vs comparators ranged from -0.37% to -1.50% for semaglutide 0.5 mg, and from -0.62% to -1.87% for semaglutide 1.0 mg; in elderly patients, ETDs ranged from -0.43% to -1.35% for semaglutide 0.5 mg, and from -0.50% to -1.55% for semaglutide 1.0 mg. HbA1c improvements with semaglutide vs comparators were similar in both age groups across the trials.

At EOT, more patients treated with semaglutide vs comparators achieved the American Diabetes Association (ADA) HbA1c target of <7% (in both age groups).¹² A higher proportion of elderly patients achieved this target than non-elderly patients. Tests for homogeneity of treatment effects were all non-significant, except for SUSTAIN 4 where more non-elderly patients treated with semaglutide 1.0 mg reached this target vs elderly patients ($P = 0.01$) (Figure S1). In non-elderly patients, HbA1c <7% was achieved by a larger proportion of patients treated with semaglutide 0.5 mg (54%-70%) and 1.0 mg

(65%-78%) vs comparators (11%-36%). In the elderly group, the corresponding proportions were 69%-92% and 67%-86% vs 11%-51%, respectively.

HbA1c <8% was achieved by 90%-100% of elderly patients treated with semaglutide 0.5 mg, and 85%-97% of elderly patients treated with semaglutide 1.0 mg, vs 47%-85% treated with comparators.

3.2 | Body weight

Semaglutide consistently reduced mean BW from baseline to EOT in both groups vs comparators (Figure 1B). With semaglutide 0.5 mg, BW reductions ranged from -3.3 to -4.3 kg (non-elderly patients) and -3.6 to -4.6 kg (elderly patients), and from -4.6 to -6.4 kg (non-elderly) and -4.1 to -6.7 kg (elderly) with semaglutide 1.0 mg. With comparators, BW ranged from +1.1 to -2.1 kg (non-elderly) and +1.5 to -1.7 kg (elderly). Changes in mean BW for semaglutide vs comparators were similar in both age groups across the trials.

In non-elderly patients, BW ≥5% was reported in 35%-43% of patients with semaglutide 0.5 mg and 46%-62% with semaglutide 1.0 mg vs 4%-20% with comparators. In elderly patients, the corresponding proportions were 37%-59% and 40%-79% vs 4%-17%, respectively. At EOT, more semaglutide- vs comparator-treated patients had ≥5% BW loss (in both age groups); the proportion was higher in the elderly than the non-elderly group. Treatment differences between age groups were not significant (except for SUSTAIN 2, $P = 0.02$) (Figure S2).

3.3 | Safety

Pooled data showed that in patients receiving semaglutide 0.5 mg, 1.0 mg and comparators, the proportion of patients experiencing AEs was comparable between the two age groups. Most AEs were mild to moderate. More elderly than non-elderly patients reported severe AEs and serious AEs with semaglutide 0.5 mg, 1.0 mg and comparators; the proportion was slightly higher with semaglutide vs comparators (Figure S3).

The proportion of patients prematurely discontinuing treatment due to AEs was higher in the elderly than the non-elderly group, and in the semaglutide vs comparator arms for both groups (Figure S3). Gastrointestinal (GI) AEs were higher with semaglutide vs comparators in both age groups, and higher in elderly vs non-elderly groups (Table S2). The proportions of patients prematurely discontinuing treatment due to GI AEs are summarized in Figure S3 and Table S3. Additional safety findings including Event Adjudication Committee-confirmed events are provided in Table S4. Changes from baseline in mean renal function are shown in Table S5.

Across the trials, the rates (events per 100 exposure years) of severe or blood glucose (BG)-confirmed hypoglycaemia events were similar between both age groups in the semaglutide arms, except for in SUSTAIN 5 where patients were on a background of basal insulin therapy (Figure S4A). In SUSTAIN 1 and 2, the rate was <2 in semaglutide-treated patients vs 0.8-13.8 in comparator arms. In SUSTAIN 3 and 4, where patients received background medication of SU, the rate was higher (Figure S4A). Patients on SU had a higher rate of hypoglycaemia than those not on SU (Figure S4B).

TABLE 1 Baseline characteristics of non-elderly and elderly patients in SUSTAIN 1-5

Mean (SD)	SUSTAIN 1		SUSTAIN 2		SUSTAIN 3		SUSTAIN 4		SUSTAIN 5		Pooled analysis of SUSTAIN 1-5 trials				
	Semaglutide		Semaglutide		Semaglutide		Semaglutide		Semaglutide		Semaglutide				
	0.5 mg	1.0 mg	0.5 mg	1.0 mg	1.0 mg	1.0 mg	0.5 mg	1.0 mg	0.5 mg	1.0 mg	0.5 mg	1.0 mg			
N															
Non-elderly	102	110	105	333	316	298	278	281	281	93	102	86	806	1141	1098
Elderly	26	20	24	76	77	88	107	84	79	39	29	47	225	293	335
Age, y															
Non-elderly	50.6 (8.3)	49.6 (9.9)	50.4 (8.9)	51.6 (8.3)	52.8 (8.5)	51.9 (8.6)	52.6 (8.1)	52.9 (8.1)	52.4 (8.6)	54.4 (8.0)	55.3 (7.4)	52.9 (8.7)	52.1 (8.2)	52.8 (8.3)	51.7 (8.5)
Elderly	70.3 (4.7)	70.0 (4.9)	69.2 (5.0)	68.8 (4.0)	69.2 (3.7)	70.1 (4.2)	69.6 (3.9)	70.3 (4.6)	69.6 (4.1)	70.4 (4.9)	69.6 (4.2)	69.6 (4.6)	69.6 (4.2)	69.5 (4.1)	69.7 (4.1)
Male, %															
Non-elderly	43.1	58.2	51.4	51.1	50.9	54.1	55.4	53.6	49.1	54.1	57.8	51.2	51.5	52.7	52.8
Elderly	61.5	80.0	66.7	48.7	46.8	54.4	58.9	57.1	55.7	54.4	62.1	57.4	54.7	55.3	57.1
Diabetes duration, y															
Non-elderly	4.6 (6.5)	3.3 (4.4)	3.6 (5.3)	5.9 (4.3)	5.9 (4.7)	8.1 (5.4)	8.1 (5.3)	7.3 (5.1)	8.5 (6.5)	7.7 (5.9)	11.6 (7.0)	11.0 (7.4)	6.9 (5.6)	7.6 (6.2)	7.2 (5.7)
Elderly	5.7 (4.4)	5.7 (6.6)	6.0 (6.1)	9.0 (5.3)	10.1 (7.5)	9.4 (6.4)	12.9 (8.7)	9.4 (5.1)	12.3 (8.6)	11.8 (6.7)	16.0 (8.1)	17.6 (7.2)	10.0 (6.4)	11.5 (7.8)	12.0 (7.9)
HbA1c, %															
Non-elderly	8.2 (0.9)	8.1 (0.8)	7.9 (0.9)	8.0 (0.9)	8.1 (0.9)	8.4 (1.0)	8.4 (1.0)	8.2 (0.9)	8.3 (1.0)	8.2 (0.9)	8.5 (0.8)	8.5 (0.9)	8.2 (0.9)	8.2 (0.9)	8.3 (0.9)
Elderly	7.7 (0.6)	8.0 (0.8)	8.0 (0.7)	8.0 (1.0)	7.9 (0.9)	8.1 (0.9)	8.1 (0.9)	7.8 (0.7)	8.1 (0.9)	7.9 (0.8)	8.1 (0.7)	8.3 (0.8)	7.9 (0.8)	8.1 (0.9)	8.1 (0.9)
BW, kg															
Non-elderly	90.8 (22.5)	99.4 (26.1)	92.0 (21.9)	90.8 (20.9)	91.2 (19.9)	97.8 (20.9)	94.6 (22.9)	93.9 (22.6)	93.8 (22.1)	94.5 (21.6)	94.3 (21.8)	92.7 (21.3)	92.5 (21.9)	94.7 (22.8)	93.8 (21.2)
Elderly	85.8 (24.6)	83.1 (17.4)	76.2 (18.8)	86.2 (17.5)	81.4 (16.3)	88.6 (17.4)	91.0 (15.2)	94.4 (22.4)	88.5 (18.8)	88.7 (12.9)	86.2 (22.9)	84.8 (19.9)	88.4 (17.0)	88.4 (20.2)	85.5 (18.3)
BMI, kg/m²															
Non-elderly	33.0 (7.5)	34.8 (8.6)	33.3 (6.7)	32.7 (6.4)	33.0 (5.9)	34.4 (7.5)	34.4 (6.4)	33.4 (6.6)	33.3 (6.6)	33.2 (6.7)	32.5 (6.4)	32.3 (6.0)	33.0 (6.6)	33.5 (7.1)	33.4 (6.3)
Elderly	30.5 (8.0)	29.1 (5.3)	28.4 (6.0)	31.1 (5.2)	30.2 (4.8)	32.4 (6.0)	31.3 (5.1)	32.3 (5.8)	31.9 (5.9)	31.6 (3.9)	30.3 (6.4)	30.9 (6.2)	31.6 (5.6)	31.8 (6.2)	30.9 (5.5)

TABLE 1 (Continued)

Mean (SD)	SUSTAIN 1		SUSTAIN 2		SUSTAIN 3		SUSTAIN 4		SUSTAIN 5		Pooled analysis of SUSTAIN 1–5 trials		
	Semaglutide		Semaglutide		Semaglutide		Semaglutide		Semaglutide		Semaglutide		
	0.5 mg	1.0 mg	0.5 mg	1.0 mg	1.0 mg	Exenatide ER	0.5 mg	1.0 mg	0.5 mg	1.0 mg	0.5 mg	1.0 mg	
MDRD eGFR, mL/min/1.73 m ²													
Non-elderly	99.6 (26.9)	105.5 (26.7)	103.4 (24.3)	101.4 (25.0)	102.1 (21.6)	103.3 (23.2)	104.5 (24.9)	105.1 (22.5)	102.6 (26.0)	102.4 (27.7)	103.9 (26.4)	101.0 (24.9)	103.5 (24.2)
Elderly	81.6 (17.2)	75.8 (19.0)	86.1 (23.5)	89.0 (21.5)	90.2 (19.1)	90.8 (17.7)	85.8 (17.2)	87.7 (17.2)	82.3 (18.8)	82.2 (20.3)	84.6 (20.5)	84.2 (20.0)	86.5 (19.4)
Blood pressure, mmHg													
Systolic													
Non-elderly	127.1 (13.3)	128.1 (13.1)	128.7 (12.6)	131.3 (15.3)	131.7 (13.7)	131.3 (13.8)	131.4 (14.1)	132.2 (14.4)	129.7 (13.2)	129.8 (15.0)	131.2 (15.4)	134.2 (14.4)	131.8 (14.2)
Elderly	131.0 (12.4)	133.3 (11.2)	133.5 (16.6)	139.1 (17.9)	136.2 (14.4)	138.4 (16.5)	140.3 (15.4)	137.6 (13.0)	137.6 (15.3)	140.8 (16.8)	136.6 (16.5)	136.5 (16.5)	140.9 (19.2)
Diastolic													
Non-elderly	80.1 (8.8)	79.5 (8.7)	79.6 (8.0)	80.6 (9.5)	81.2 (8.8)	80.8 (8.6)	80.4 (8.6)	80.5 (8.6)	80.2 (7.8)	80.4 (8.5)	80.5 (8.9)	79.4 (9.3)	81.6 (8.5)
Elderly	77.1 (9.8)	77.8 (7.4)	77.0 (9.8)	80.6 (10.9)	79.3 (10.0)	79.3 (9.2)	79.5 (8.8)	77.0 (8.8)	77.9 (8.5)	80.1 (7.5)	77.1 (9.8)	77.8 (10.7)	75.3 (10.5)
Not available													

Abbreviations: BMI, body mass index; BW, body weight; eGFR, estimated glomerular filtration rate; ER, extended release; IGl, insulin glargine; MDRD, modification of diet in renal disease. All values are mean (SD) apart from age, which is mean (range). Non-elderly: <65 years; elderly: ≥65 years.

Mean pulse rate increased in all treatment groups with greater increases for semaglutide vs comparators and elderly vs non-elderly patients (elderly: 2.6, 3.5 vs 0.5 bpm vs non-elderly: 1.7, 2.5 vs 0.4 bpm with semaglutide 0.5 mg, 1.0 mg vs comparator).

4 | DISCUSSION

This pooled analysis of SUSTAIN 1-5 assessed the efficacy and safety profile of semaglutide vs placebo and active comparators in elderly and non-elderly patients.

Semaglutide consistently improved HbA1c and BW vs comparators in both elderly and non-elderly patients. Furthermore, >85% of semaglutide-treated elderly patients achieved the less stringent target of HbA1c <8% frequently used in this patient population.

Irrespective of age, more patients had a BW loss of ≥5% with semaglutide vs comparators, with no significant difference between elderly and non-elderly patients (except in SUSTAIN 2). While BW reduction is beneficial in obese or overweight patients, it may not be desirable in all elderly patients with T2D who are prone to undernutrition.^{2,5} Previous *post hoc* studies on BW loss across SUSTAIN 1-5 showed that the greatest reductions occurred in patients in the

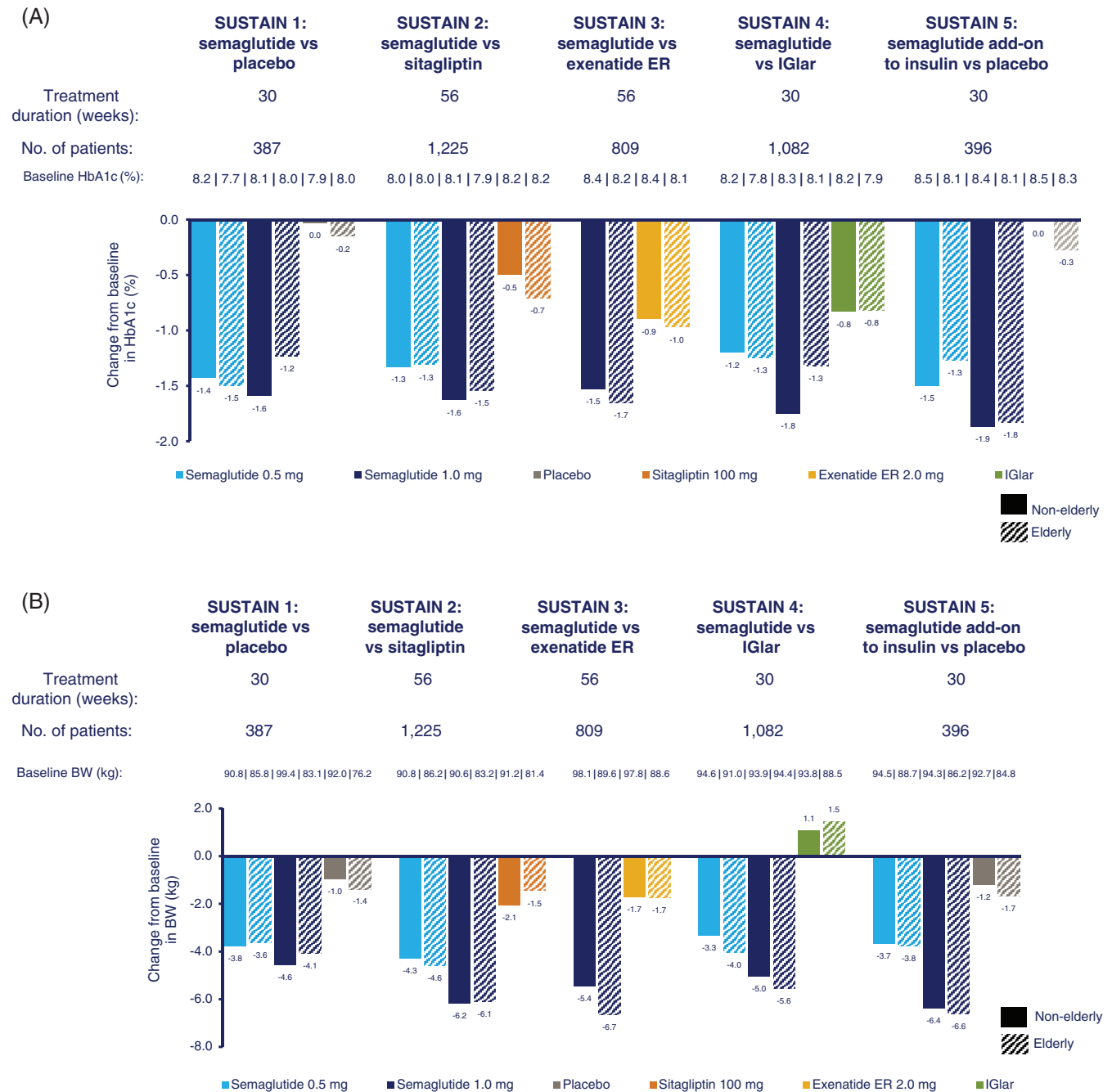


FIGURE 1 Change from baseline to end of treatment in HbA1c (A) and BW (B) by age group in SUSTAIN 1-5. Abbreviations: BW, body weight; exenatide ER, exenatide extended release; IGlar, insulin glargine. In part A, all tests for treatment by subgroup interaction (<65/≥65 years) were non-significant (except for SUSTAIN 4) between patients treated with semaglutide 1.0 mg and IGlar ($P < 0.02$). In part B, all tests for treatment by subgroup interaction (<65/≥65 years) were non-significant. Non-elderly: <65 years; elderly: ≥65 years

highest BMI subgroup (≥ 35 kg/m²). Hence physicians should individualize treatment based on the patient's baseline BMI.

Hypoglycaemia is a major concern in elderly individuals with T2D, particularly with basal insulin and SU.¹³ This study confirms a higher rate of hypoglycaemia in elderly vs non-elderly patients, irrespective of treatment; higher rates were seen in patients who received insulin glargine or those on background SU vs those who didn't. Semaglutide was associated with a low risk of severe hypoglycaemia (in the absence of concomitant treatment with SUs or insulin), and might therefore be considered as a potential treatment option with an acceptable safety profile for elderly patients with T2D who are at high risk of hypoglycaemia.

Overall, similar proportions of patients experienced AEs in both age groups, with most AEs being mild to moderate. Semaglutide had a similar safety profile to that of other GLP-1RAs, with no additional clinically relevant risks observed in elderly patients.¹⁴ Across the semaglutide and comparator arms, elderly patients had higher incidences of Event Adjudication Committee-confirmed events (neoplasms, CV events and pancreatitis) compared with non-elderly patients, which is consistent with the increased risk of these events in elderly patients in the general population.^{15,16}

There were more GI AEs leading to premature treatment discontinuations in the elderly group. This may reflect a difference in GI tolerability in older individuals. Hence semaglutide, like all GLP-1RAs, should be used with caution in elderly patients who are frail, due to the GI AEs and potential BW loss associated with this drug class. Despite higher premature treatment discontinuations due to AEs in elderly patients, a dose-dependent effect was not observed.

Mean reductions in renal function were lower in elderly than in non-elderly patients; the reason for this is unknown. Elderly patients had a lower estimated glomerular filtration rate (eGFR) at baseline than non-elderly patients; these findings are encouraging as they indicate no further reduction in renal function.

A limitation of this *post hoc* analysis was that the elderly group comprised approximately one fifth of the total population analyzed. It wasn't feasible to compare outcomes between patients ≥ 75 years (a cut-off point recommended by some geriatric societies for defining the elderly)¹⁷ and < 75 years, as there were only 156 patients ≥ 75 years across SUSTAIN 1-5, representing 3% of the total trial population (Novo Nordisk, data on file). This proportion is too low to allow any meaningful comparison, therefore caution should be exercised when interpreting the data with respect to patients ≥ 75 years.

In summary, this pooled analysis demonstrated the efficacy and safety of semaglutide in more than 850 elderly (≥ 65 years) patients, a population that typically presents with several baseline comorbidities. Semaglutide consistently improved HbA1c and BW vs comparators in elderly and non-elderly patients with T2D. Combined with findings from SUSTAIN 6, which demonstrated CV benefit with semaglutide in patients whose average age was 65 years, semaglutide may be an effective treatment option for elderly patients with T2D.

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Conflicts of interest

M. W. has received research support from Novo Nordisk, Eli Lilly, Janssen, Shire, Pfizer, Mylan and Sanofi; is on the advisory panel of Novo Nordisk, Sanofi and Eli Lilly; and is on the speaker's bureau of Novo Nordisk, Eli Lilly, Janssen, AstraZeneca, Sanofi, Merck, Shire and Mannkind. L. C. is a consultant for Novo Nordisk and is on the advisory board of Intarcia Therapeutics. D. T. is on the advisory panel of Novo Nordisk and has received research support from Novo Nordisk, Sanofi Aventis and Sanofi. G. N. and N. W. are full-time employees of Novo Nordisk. B. C. is a consultant for Novo Nordisk; has received research support from Pfizer, Sanofi and Regeneron; and has received honoraria from Amgen, Pierre Fabre, Eli Lilly, MSD, Merck & Co, Novo Nordisk, Regeneron and Sanofi.

Author contributions

M. W.: writing the manuscript; L. C.: study design, study conduct, data analysis, recommendations for writing group; D. T.: writing the manuscript; G. N.: data analysis, writing the manuscript; N. W.: study design, study conduct/data collection, data analysis, writing the manuscript; B. C.: study conduct/data collection, critical revision of the manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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