

Supplementary Tables and Figures

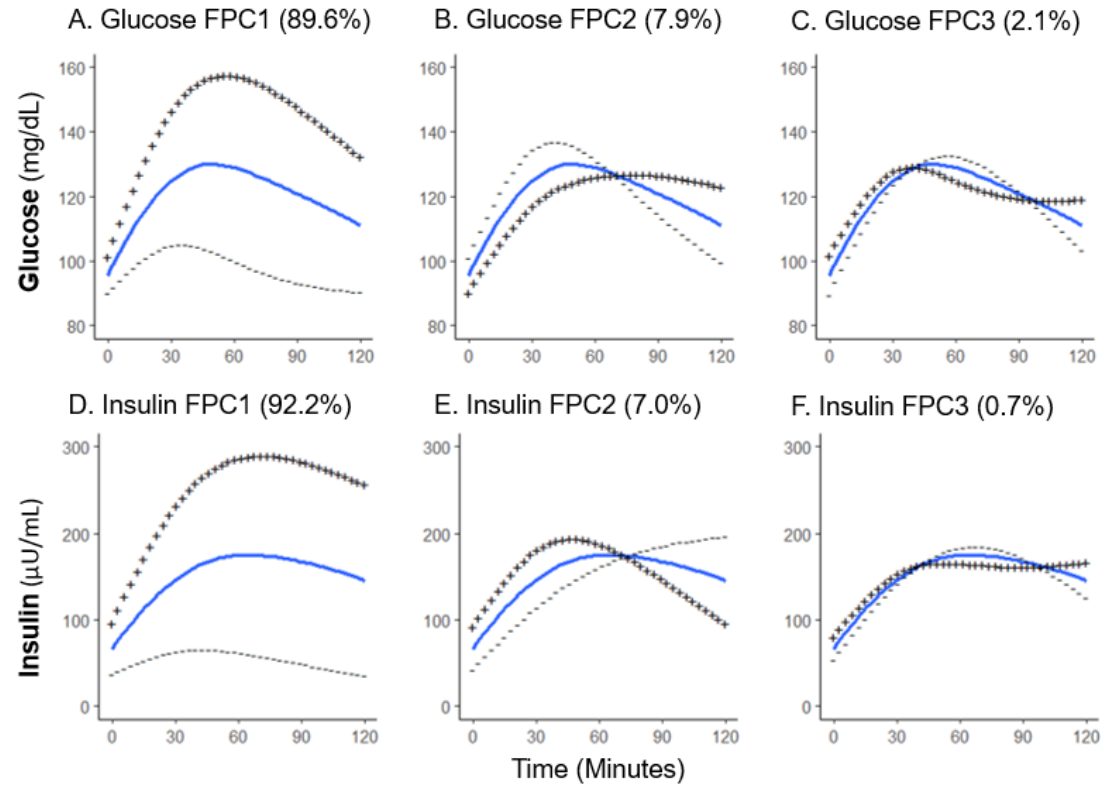


Figure S1. Fitted FPC curves for glucose and insulin (% variance explained). Fitted curves are shown for average glucose (A-C) and insulin (D-F) FPCs with +/- curves indicating the fitted curve for one standard deviation +/- the mean score for each FPC (error designation calculated as in Frøslie et al. [20]). Percent variance explained is the proportion of variance in fitted curves for each participant explained by each FPC. Abbreviations: FPC, functional principal component.

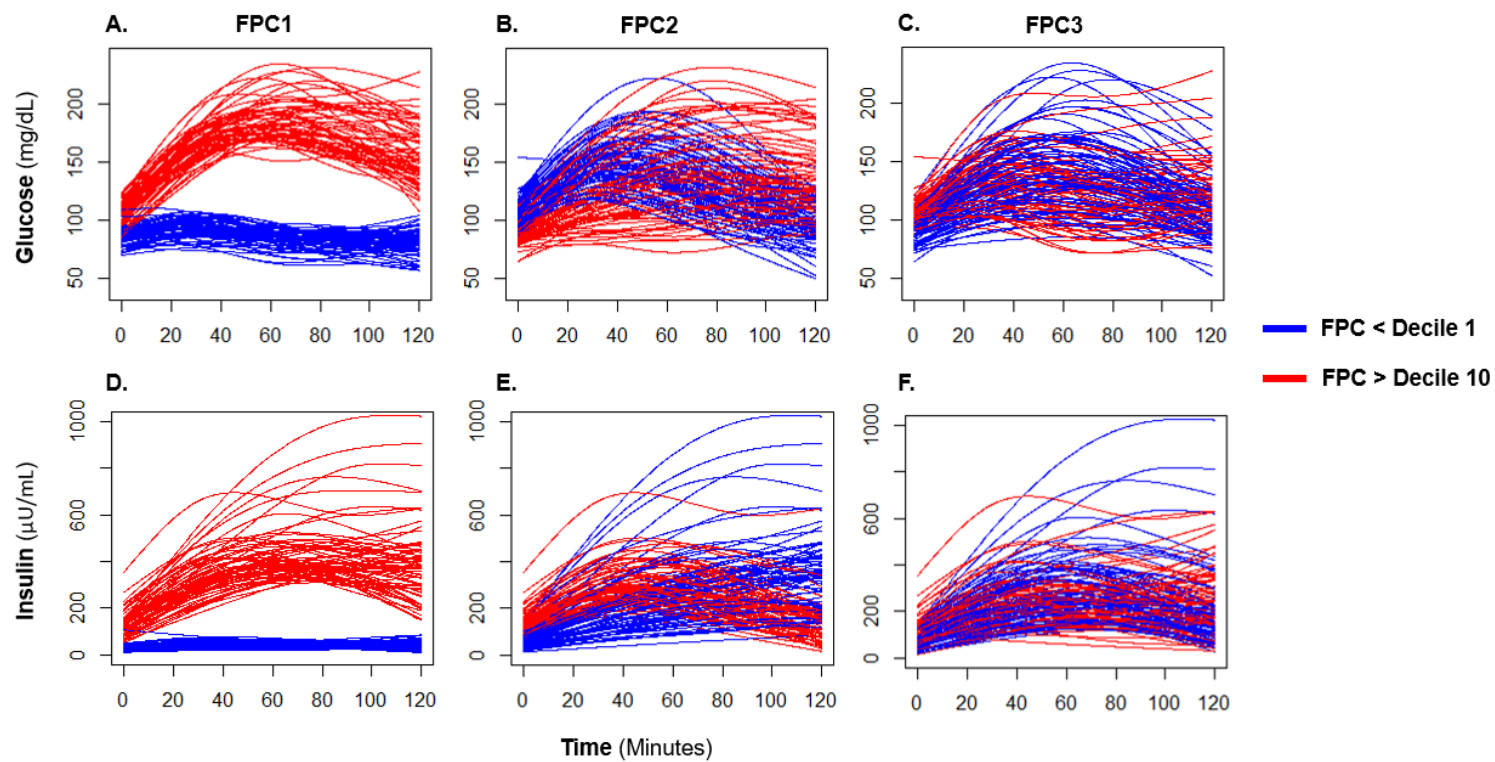


Figure S2. Curves from extreme deciles of each FPC. Fitted curves are shown from participants from extreme deciles of the three glucose (A-C) and insulin (D-F) FPCs. Participants with extreme values were selected separately for each FPC, so the subset of participants included in each plot is not the same. Abbreviations: FPC, functional principal component.

Table S1. Metabolic health parameters by shape classification (cross-sectional)

Characteristic	Monophasic, n = 368¹	Biphasic, n = 282¹	Incessant Increase, n = 17¹	p-value²
Age (Years)	13.7 [12.1, 15.5]	12.8 [11.2, 15.0]	14.6 [11.7, 15.69]	<0.001
Sex				0.174
Female	188 (52%)	159 (44%)	12 (3.3%)	
Male	179 (58%)	123 (40%)	5 (1.6%)	
Race				0.272
White	225 (59%)	152 (40%)	7 (1.8%)	
Black or African American	107 (51%)	95 (45%)	7 (3.3%)	
Other/Multiracial	25 (48%)	25 (48%)	2 (3.8%)	
Unknown/Not Reported	10 (48%)	10 (48%)	1 (4.7%)	
Ethnicity				0.034
Non-Hispanic/Latino	342 (55%)	271 (43%)	14 (2.2%)	
Hispanic/Latino	25 (64%)	11 (28%)	3 (7.7%)	
BMI Percentile	97.3 [94.7, 98.9]	96.8 [93.4, 98.6]	96.6 [94.6, 97.8]	0.051
Waist Circumference (cm)	93 [85, 104]	88 [80, 98]	85 [81, 94]	<0.001
Systolic BP (mmHg)	115 [107, 124]	112 [106, 121]	113 [106, 115]	0.037
Diastolic BP (mmHg)	63 [59, 68]	62 [58, 67]	63 [60, 68]	0.567
HbA1c (%)	5.4 [5.1, 5.7]	5.3 [5.1, 5.6]	5.6 [5.1, 5.7]	0.143
Total Cholesterol (mg/dL)	147 [128, 168]	147 [126, 166]	153 [133, 181]	0.561
HDL Cholesterol (mg/dL)	42 [36, 50]	44 [36, 53]	44 [34, 57]	0.181
LDL Cholesterol (mg/dL)	95 [79, 115]	93 [76, 112]	103 [81, 111]	0.339
Triglycerides (mg/dL)	79 [56, 109]	70 [50, 102]	93 [65, 115]	0.017
FPG (mg/dL)	89 [83, 95]	88 [82, 95]	83 [81, 88]	0.214
2hrPG (mg/dL)	107 [92, 125]	108 [96, 124]	131 [119, 144]	<0.001

Abbreviations: BMI, body mass index; BP, blood pressure; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FPG, fasting plasma glucose; 2hrPG, 2-hour plasma glucose; Q1, 1st quartile; Q3, 3rd quartile.

1. Median [Q1, Q3]; n (%); shape classifications were undetermined for five participants. Variable-specific missingness existed for BP (n = 21), waist circumference (n = 24), and lipid labs (n = 10).

2. Kruskal-Wallis test (continuous characteristics) or Fisher's exact test (categorical characteristics).

Table S2. Univariate linear regression of standardized glucose FPCs by demographic characteristics (cross-sectional)

Characteristic (Independent Variable) ¹	Dependent Variable											
	Glucose FPC1				Glucose FPC2				Glucose FPC3			
	Beta	95% CI	p-value	R ²	Beta	95% CI	p-value	R ²	Beta	95% CI	p-value	R ²
Age (Years)²	-0.02	-0.05, 0.01	0.247	0.002	-0.02	-0.06, 0.01	0.154	0.003	-0.05	-0.08, -0.02	0.002	0.014
Sex³				0.006				0.036				0.000
<i>Female</i>	—	—			—	—			—	—		
<i>Male</i>	0.15	0.00, 0.30	0.054		-0.38	-0.53, -0.23	<0.001		0.00	-0.16, 0.15	0.951	
Race³				0.025				0.052				0.003
<i>White</i>	—	—			—	—			—	—		
<i>Black or African American</i>	-0.30	-0.47, -0.13	<0.001		0.50	0.34, 0.66	<0.001		-0.06	-0.23, 0.11	0.503	
<i>Other/Multiracial</i>	-0.37	-0.66, -0.08	0.012		0.26	-0.02, 0.55	0.068		-0.13	-0.42, 0.16	0.363	
<i>Unknown/Not Reported</i>	0.10	-0.34, 0.53	0.656		0.12	-0.31, 0.55	0.571		0.18	-0.26, 0.62	0.434	
Ethnicity³				0.003				0.000				0.000
<i>Non-Hispanic/Latino</i>	—	—			—	—			—	—		
<i>Hispanic/Latino</i>	0.22	-0.10, 0.54	0.185		0.03	-0.29, 0.36	0.839		-0.03	-0.35, 0.29	0.856	

Abbreviations: FPC, functional principal component; CI, confidence interval.

1. Each independent variable (rows) and FPC (columns) combination represents a separate univariable linear regression model.
2. Betas are interpreted as the standard deviation difference in each glucose FPC per each additional year of age.
3. Betas are interpreted as the standard deviation difference in each glucose FPC associated with each category relative to the reference level.

Table S3. Univariate linear regression of standardized insulin FPCs by demographic characteristics (cross-sectional)

Characteristic (Independent Variable) ¹	Dependent Variable											
	Insulin FPC1				Insulin FPC2				Insulin FPC3			
	Beta	95% CI	p-value	R ²	Beta	95% CI	p-value	R ²	Beta	95% CI	p-value	R ²
Age (Years)²	0.00	-0.03, 0.03	0.908	0.000	0.02	-0.01, 0.05	0.172	0.003	-0.05	-0.08, -0.01	0.004	0.012
Sex³				0.017				0.013				0.008
<i>Female</i>	—	—			—	—			—	—		
<i>Male</i>	-0.26	-0.41, -0.11	<0.001		0.23	0.07, 0.38	0.003		-0.18	-0.33, -0.03	0.022	
Race³				0.002				0.012				0.012
<i>White</i>	—	—			—	—			—	—		
<i>Black or African American</i>	0.08	-0.08, 0.25	0.327		0.17	0.01, 0.34	0.042		0.19	0.02, 0.36	0.025	
<i>Other/Multiracial</i>	0.14	-0.15, 0.43	0.339		0.05	-0.23, 0.34	0.712		0.22	-0.07, 0.51	0.132	
<i>Unknown/Not Reported</i>	-0.02	-0.46, 0.42	0.937		-0.37	-0.81, 0.07	0.098		0.38	-0.06, 0.82	0.087	
Ethnicity³				0.002				0.000				0.000
<i>Non-Hispanic/Latino</i>	—	—			—	—			—	—		
<i>Hispanic/Latino</i>	0.20	-0.12, 0.53	0.220		-0.08	-0.41, 0.24	0.613		-0.09	-0.42, 0.23	0.576	

Abbreviations: FPC, functional principal component; CI, confidence interval.

1. Each independent variable (rows) and FPC (columns) combination represents a separate univariable linear regression model.
2. Betas are interpreted as the standard deviation difference in each insulin FPC per each additional year of age.
3. Betas are interpreted as the standard deviation difference in each insulin FPC associated with each category relative to the reference level.

Table S4. Adjusted linear regression models of standardized glucose FPCs by metabolic health parameters (cross-sectional)

Independent Variable	Dependent Variable											
	Glucose FPC1 ¹				Glucose FPC2 ¹				Glucose FPC3 ¹			
	Beta	95% CI	p-value	Adjusted R ²	Beta	95% CI	p-value	Adjusted R ²	Beta	95% CI	p-value	Adjusted R ²
BMI Percentile	0.061	0.042, 0.081	<0.001	0.076	0.015	-0.004, 0.035	0.128	0.077	-0.003	-0.023, 0.017	0.785	0.007
Waist Circumference (cm)	0.010	0.004, 0.015	0.001	0.040	0.006	0.000, 0.011	0.038	0.079	-0.004	-0.010, 0.002	0.155	0.010
Systolic BP (per 10 mmHg)	0.054	-0.011, 0.120	0.106	0.028	-0.036	-0.100, 0.029	0.278	0.070	-0.066	-0.132, -0.001	0.048	0.014
Diastolic BP (per 10 mmHg)	0.116	0.010, 0.221	0.031	0.032	-0.095	-0.198, 0.008	0.070	0.074	-0.057	-0.163, 0.048	0.286	0.010
HbA1c (%)	0.733	0.557, 0.908	<0.001	0.113	0.060	-0.120, 0.239	0.514	0.075	0.280	0.095, 0.465	0.003	0.020
FPG (per 10 mg/dL)	0.485	0.414, 0.557	<0.001	0.229	-0.297	-0.372, -0.221	<0.001	0.151	0.572	0.503, 0.640	<0.001	0.293
2hrPG (per 10 mg/dL)	0.319	0.301, 0.336	<0.001	0.665	0.169	0.143, 0.195	<0.001	0.255	0.136	0.107, 0.164	<0.001	0.123
Triglycerides (per 10 mg/dL)	0.044	0.027, 0.062	<0.001	0.059	0.013	-0.005, 0.030	0.147	0.079	-0.003	-0.021, 0.016	0.783	0.007
HDL Cholesterol (per 10 mg/dL)	0.122	0.059, 0.185	<0.001	0.045	-0.020	-0.082, 0.042	0.525	0.076	0.169	0.106, 0.232	<0.001	0.047
LDL Cholesterol (per 10 mg/dL)	0.043	0.014, 0.071	0.004	0.037	0.015	-0.013, 0.043	0.290	0.077	0.007	-0.022, 0.036	0.644	0.007
Total Cholesterol (per 10 mg/dL)	0.052	0.026, 0.077	<0.001	0.047	0.006	-0.019, 0.032	0.627	0.076	0.027	0.001, 0.053	0.043	0.013

Abbreviations: BMI, body mass index; BP, blood pressure; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FPG, fasting plasma glucose; 2hrPG, 2-hour plasma glucose.

1. Model adjusted for age, sex, race, and ethnicity. Each independent variable (rows) and FPC (columns) combination represents a distinct regression model. Betas are interpreted as adjusted increase in each glucose FPC per unit (or 10 unit) change in the metabolic health parameter. Variable-specific missingness existed for BP (n = 21), waist circumference (n = 24), and lipid labs (n = 10).

Table S5. Adjusted linear regression models of standardized insulin FPCs by metabolic health parameters (cross-sectional)

Independent Variable	Dependent Variable											
	Insulin FPC1 ¹				Insulin FPC2 ¹				Insulin FPC3 ¹			
	Beta	95% CI	p-value	Adjusted R ²	Beta	95% CI	p-value	Adjusted R ²	Beta	95% CI	p-value	Adjusted R ²
BMI Percentile	0.106	0.087, 0.124	<0.001	0.169	0.015	-0.005, 0.035	0.150	0.023	0.017	-0.003, 0.037	0.103	0.025
Waist Circumference (cm)	0.032	0.027, 0.037	<0.001	0.191	0.005	-0.001, 0.011	0.077	0.026	0.002	-0.003, 0.008	0.422	0.018
Systolic BP (per 10 mmHg)	0.147	0.082, 0.212	<0.001	0.040	0.084	0.020, 0.149	0.011	0.028	-0.036	-0.101, 0.029	0.275	0.022
Diastolic BP (per 10 mmHg)	0.200	0.095, 0.304	<0.001	0.031	0.113	0.009, 0.217	0.033	0.025	-0.077	-0.181, 0.027	0.148	0.023
HbA1c (%)	0.417	0.234, 0.599	<0.001	0.039	-0.027	-0.211, 0.158	0.778	0.020	0.150	-0.034, 0.335	0.110	0.025
FPG (per 10 mg/dL)	0.135	0.054, 0.215	0.001	0.026	0.075	-0.006, 0.155	0.069	0.024	0.079	-0.002, 0.159	0.056	0.026
2hrPG (per 10 mg/dL)	0.166	0.139, 0.194	<0.001	0.185	-0.152	-0.180, -0.124	<0.001	0.166	0.119	0.090, 0.148	<0.001	0.110
Triglycerides (per 10 mg/dL)	0.091	0.075, 0.108	<0.001	0.160	0.009	-0.009, 0.027	0.349	0.021	0.016	-0.002, 0.034	0.078	0.025
HDL Cholesterol (per 10 mg/dL)	-0.085	-0.149, -0.021	0.010	0.022	-0.041	-0.105, 0.024	0.215	0.022	0.007	-0.057, 0.071	0.825	0.021
LDL Cholesterol (per 10 mg/dL)	0.066	0.037, 0.094	<0.001	0.041	-0.008	-0.037, 0.021	0.587	0.020	0.019	-0.010, 0.048	0.191	0.023
Total Cholesterol (per 10 mg/dL)	0.038	0.012, 0.064	0.005	0.024	-0.015	-0.041, 0.011	0.268	0.021	0.020	-0.006, 0.046	0.141	0.024

Abbreviations: FPC, functional principal component; BMI, body mass index; BP, blood pressure; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FPG, fasting plasma glucose; 2hrPG, 2-hour plasma glucose

1. Model adjusted for age, sex, race, and ethnicity. Each independent variable (rows) and FPC (columns) combination represents a distinct regression model. Betas are interpreted as adjusted increase in each insulin FPC per unit (or 10 unit) change in the metabolic health parameter. Variable-specific missingness existed for BP (n = 21), waist circumference (n = 24), and lipid labs (n = 10).

Table S6. Longitudinal subset participant characteristics at baseline, comparison to cross-sectional sample

Characteristic	Participants in longitudinal subset, ¹ N = 193 ²	Participants in cross-sectional sample only, N = 478 ²	p-value ³
Age (Years)	13.3 [11.5, 15.3]	13.5 [11.6, 15.4]	0.229
Sex			0.549
<i>Female</i>	108 (56%)	254 (53%)	
<i>Male</i>	85 (44%)	224 (47%)	
Race			0.006
<i>White</i>	104 (54%)	282 (59%)	
<i>Black or African American</i>	55 (28%)	157 (33%)	
<i>Other/Multiracial</i>	24 (12%)	28 (5.9%)	
<i>Unknown</i>	10 (5.2%)	11 (2.3%)	
Ethnicity			0.100
<i>Non-Hispanic/Latino</i>	177 (92%)	455 (95%)	
<i>Hispanic/Latino</i>	16 (8.3%)	23 (4.8%)	
BMI Percentile	96.2 [92.1, 98.6]	97.3 (94.6, 98.9)	0.005
FPG (mg/dL)	83 [79, 90]	91 [85, 97]	<0.001
2hrPG (mg/dL)	99 [86, 114]	112 [98, 128]	<0.001
HbA1c (%)	5.2 [5.0, 5.4]	5.4 [5.2, 5.7]	<0.001
Baseline Dysglycemia			<0.001
<i>No</i>	179 (93%)	340 (71%)	
<i>Yes</i>	14 (7.3%)	138 (29%)	

Abbreviations: BMI, body mass index; FPG, fasting plasma glucose; 2hrPG, 2-hour plasma glucose; HbA1c, hemoglobin A1c; Q1, 1st quartile; Q3, 3rd quartile.

1. The Longitudinal subset is defined as participants with baseline and follow up data for whom at least six months passed between visits.

2. Median [Q1, Q3] or n (%).

3. Wilcoxon rank sum test (continuous characteristics) or Fisher's exact test (categorical characteristics).