Association between Dietary Intake Pattern and A1c in Low-Income African Americans with Type 2 Diabetes Mellitus

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Outline

- Introduction
- Review of Literature
- Purpose
- Methods
- Statistics
- Results
- Discussion
- Conclusions
- Future Implications
- References

Introduction-Diabetes

- Prevalence
  - 29.1 million people affected in 2012[1]
  - 90-95% of cases were type 2 diabetes[1]
- Demographics
  - 13.1% of African Americans vs. 7.6% of non-Hispanic white individuals[1]

[1]American Diabetes Association (2011). Data from the 2011 National Diabetes Fact Sheet. American Diabetes Association. Jan. 26, 2011.
[2]American Diabetes Association (2001). Postprandial Blood Glucose. Diabetes Care. 24 (4). 775-778.

Introduction-Diabetes

- Complications
  - 2-4x higher death rate from heart disease[1]
- Causes
  - Postprandial hyperglycemia has been shown to have an atherogenic effect correlating with CVD mortality[2]

[1]American Diabetes Association (2011). Data from the 2011 National Diabetes Fact Sheet. American Diabetes Association. Jan. 26, 2011.
[2]American Diabetes Association (2001). Postprandial Blood Glucose. Diabetes Care. 24 (4). 775-778.

Introduction-Dietary Intake

- Distribution of calorie and food intake affects postprandial blood glucose response[3,4,5]
  - Fewer eating events results in higher calorie and grams of carbohydrate at each eating event
- Insulin sensitivity decreases throughout the day
  - Carbohydrate at the "dinner meal" resulted in [8, 9, 12]
    - Higher mean glucose
    - Higher peak blood glucose
  - Carbohydrate may be better tolerated when administered at the "lunch meal" [9, 12, 13]

[3]Beebe, C. A., Pastors, J. G., Powers, M. A., & Wylie-Rosett, J. (1991). Nutrition management for individuals with noninsulin-dependent diabetes mellitus in the 1990s: A review by the diabetes care and education dietetic practice group. Journal of the American Dietetic Association, 91(2), 196-202+205-207.
[4]Bertelsen, J., Christiansen, C., Thomsen, C., Poulsen, P. L., Vestergaard, S., Steinov, A., . . . Hermansen, K. (1993). Effect of meal frequency on blood glucose, insulin, and free fatty acids in NIDDM subjects. Diabetes Care, 16(1), 4-7.
[5]Jenkins, D. J. A., Ocana, A., Jenkins, A. L., Wolever, T. M. S., Vuksan, V., Katzman, L., Josse, R. G. (1992). Metabolic advantages of spreading the nutrient load: Effects of increased meal frequency in non-insulin-dependent diabetes. American Journal of Clinical Nutrition, 55(2), 461-467
[6]Reutrakul, S. Hood, M. Crowley, S. Morgan, M. Teodori, M. Knutson, K. Cauter, E. (2013). Chronotype is independently associated with glycemic control in type 2 diabetes. American Diabetes Association. 36(9): 2523-2529.
[7]Reutrakul, S, Hood, M, Crowley, J. The relationship between breakfast skipping, chronotype and glycemic control in type 2 diabetes. Informa healthcare. 1-8 (2013)

Introduction-Dietary Intake

- Dietary intake pattern
  - No set recommendation to promote optimal blood glucose
- Patterns resulting in poor glycemic control [6,7]
  - Larger percent of kilocalories at dinner
  - Skipping breakfast

[3]Beebe, C. A., Pastors, J. G., Powers, M. A., & Wylie-Rosett, J. (1991). Nutrition management for individuals with noninsulin-dependent diabetes mellitus in the 1990s: A review by the diabetes care and education dietetic practice group. Journal of the American Dietetic Association, 91(2), 196-202+205-207.

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Dietary Intake Patterns

- Reutrakul et al.[6,7]
  - Larger percent of kilocalories at dinner
  - Skipping breakfast
- Subjects
  - Adults with type 2 diabetes
  - Followed in endocrinology or primary care clinics at RUMC
- Measures
  - Demographic: Age, race, weight, height, current medications
  - Laboratory: HbA1c (primary outcome variable)
  - Intake: 24 hour dietary recall (one)
  - Sleeping habits: mid-sleep time on free days (MSF)

6. Reutrakul, S. Hood, M. Crowley, S. Morgan, M. Teodori, M. Knutson, K. Cauter, E. (2013). Chronotype is independently associated with glycemic control in type 2 diabetes. American Diabetes Association. 36(9): 2523-2529.
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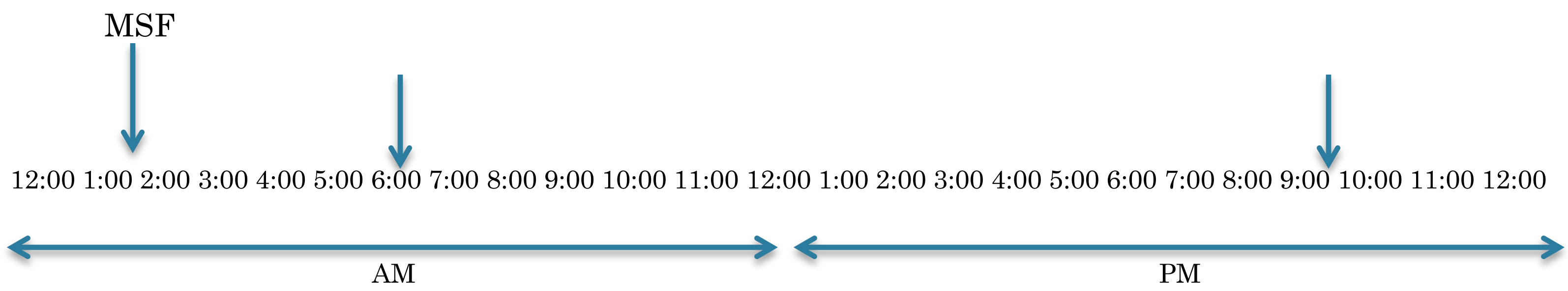
Reutrakul et al.

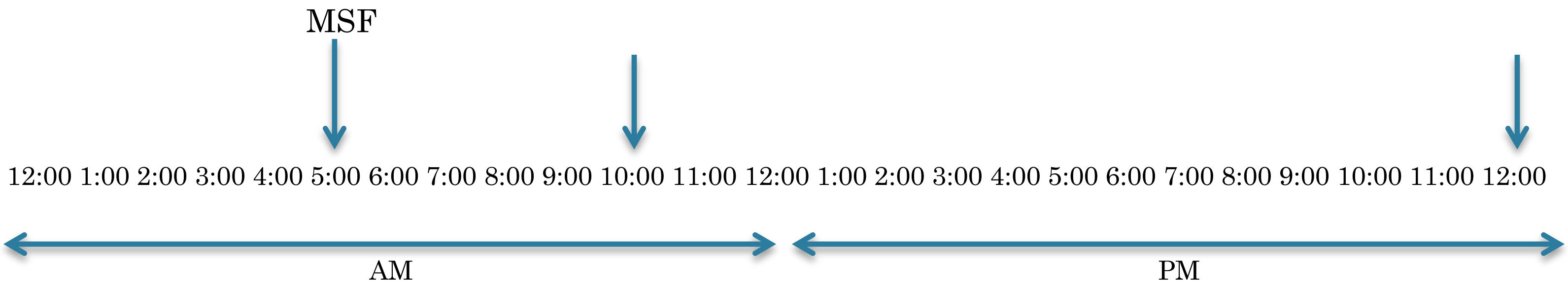
Mid-sleep time on free days (MSF)



$$\frac{\text{9:00 pm- 6:00 am}}{2} = \text{1:30 am}$$

Reutrakul et al.

Mid-sleep time on free days (MSF)



$$\frac{\text{12:00 pm} - \text{10:00 am}}{2} = \text{5:00 am}$$

Reutrakul et al.

Table 2. Pearson correlation (r) between demographics and circadian, sleep, and dietary parameters and natural log of HbA_{1c} (n=194)		
	R	P
Age (years)	-0.25	<0.001
BMI (kg/m^2)	0.09	0.19
CES-D (depression) score	0.20	0.005
Circadian parameters		
Chronotype (MSF)	0.34	<0.001
Sleep parameters		
Sleep duration (h)	-0.01	0.90
Perceived sleep debt (h)	0.15	0.04
PSQI score	0.09	0.22
Dietary parameters		
Breakfast calories (% of daily total)	-0.11	0.13
Dinner calories (% of daily total)	0.26	<0.001
Breakfast time	0.13	0.13
Dinnertime	0.11	0.14

6. Reutrakul, S., Hood, M., Crowley, S., Morgan, M., Teodori, M., Knutson, K., Cauter, E. (2013) Chronotype is Independently Associated with Glycemic Control in Type 2 Diabetes. Diabetes Care 36(9) 1-7.

Reutrakul et al.

Table 3. Hierarchical regression analysis with natural log of HbA_{1c} as the outcome (n=194)		
Variable	B	P
Age	-0.003	0.003
Sex (reference: male)	0.016	0.598
Race (reference: nonwhite)	-0.028	0.360
BMI	-0.001	0.526
DM complications	0.031	0.298
Insulin use	0.126	<0.001
CES-D	0.0001	0.957
Perceived sleep debt	-0.002	0.796
Chronotype (MSF)	0.025	0.001
Adjusted R^2	0.24	
ΔR^2	0.043	0.001

6. Reutrakul, S., Hood, M., Crowley, S., Morgan, M., Teodori, M., Knutson, K., Cauter, E. (2013) Chronotype is Independently Associated with Glycemic Control in Type 2 Diabetes. Diabetes Care 36(9) 1-7.

Reutrakul et al.

Table 4. Multiple regression analysis predicting natural log of HbA1c (n=194)				
	Model 1		Model 2	
Variable	B	P	B	P
Age	-0.003	0.002	-0.003	0.009
Sex (reference: male)	0.013	0.655	0.015	0.610
Race (reference: nonwhite)	-0.019	0.528	-0.024	0.423
BMI	-0.001	0.714	-0.001	0.466
Number of DM complications	0.038	0.196	0.031	0.299
Insulin use	0.137	<0.001	0.144	<0.001
CES-D	0.0001	0.936	0.0004	0.786
Perceived sleep debt	0.001	0.849	-0.0001	0.994
Percentage of daily caloric intake at dinner	0.0018	0.005	0.0014	0.038
Breakfast skipping			0.108	0.012
Adjusted R^2	0.23		0.25	
ΔR^2			0.03	0.012

7. Reutrakul, S, Hood, M, Crowley, J. The relationship between breakfast skipping, chronotype and glycemic control in type 2 diabetes. Informa healthcare. 1-8 (2013)

Purpose

1. To describe the dietary intake pattern of subjects with type 2 diabetes.
2. To describe meal skipping behavior between two 24-hour dietary recalls.
3. To determine the association between dietary intake pattern and HbA1c.
4. To determine the association between meal skipping behavior and HbA1c.

Research Design

- Cross-sectional, observational design
- Baseline data from the Lifestyle Improvement through Food and Exercise (LIFE) trial
  - Randomized controlled trial
  - Low-income African Americans with type 2 diabetes mellitus
- Dietary intake
  - Two 24-hour dietary recalls

Setting and Sample

211 subjects (6 cohorts)

Cohort	Clinic	Date
C1	Austin Health Center	Spring 2012
C2	Austin Health Center	Summer 2012
C3	Englewood Health Center	Winter 2012
C4	Woodlawn Health Center	Summer 2013
C5	Near South	Fall 2013
C6	Oak Forest Health Center	Spring 2014

Recruitment

Potential subjects screened from the patient database of John H. Stroger, Jr. Hospital and associated clinics within Cook County

↓

List of subjects sent to principal investigator

↓

Subjects approached in clinic or via phone

Inclusion Criteria

- Self declared African American descent
- >18 years old
- Type 2 diabetes with hemoglobin A1c≥7%
- Patient of Cook County Hospital
- Clearance by a primary care physician
- Ability to engage in moderate level of physical activity

Exclusion Criteria

- Body mass index (BMI) ≤18.5 and ≥55
- HbA1c <7%
- <18 years of age
- Non-Cook County clinic
- Didn‘t visit a medical clinic annually
- Diet-controlled diabetes
- Major psychiatric disorder
- Cognitive impairment
- Taking prednisone or steroids
- Illicit drug use or alcohol abuse
- Unable to give informed consent
- Could not engage in physical activity
- No access to a telephone
- Restrictive vision problems
- Sickle cell trait
- End-stage renal disease
- Stroke with paresis
- Congestive heart failure
- Comorbidity that limits lifespan <4 years

Baseline Data

Day 1	Day 2
24 hour recall	24 hour recall
Distributed accelerometers	Collected accelerometers
Administered questionnaires	

Measures & Instruments

Measures	**Instrument**
Demographic characteristics	LIFE general participant form
Clinical and physical measures	LIFE physical measures form
Medical history	LIFE medical history form
Psychosocial measures	9-item Patient Health Questionnaire (PHQ-9)
Physical activity	Accelerometer
Nutrient intake	Multiple Pass Method, Nutrition Data System for Research (NDSR)

Dietary Intake Data

- Data collection
  - The Multiple Pass Method[14]
  - Nutrition Data System for Research[15]
    - Developed by the Nutrition Coordinating Center (NCC) University of Minnesota, (Minneapolis, MN)
    - NDSR software version 2011-2014

14. Blanton, C. Moshfegh, A. Baer, D. Kretsch, M. The USDA Automated Multiple-Pass Method Accurately Estimates Group Energy and Nutrient Intake. *The Journal of Nutrition.* 136(10): 2594-2599.
15. Shackel SF. Buzzard IM, Gebhardt SE. Procedures for estimating nutrient values for food composition databases. J Food Comp and Anal. 1997; 10:102-114.

NDSR-Extracted Variables

Variables	
Meal (as stated by subject)	Meal time (24 clock time)
Total Grams (g)	Energy (kcals)
Total Fat (g)	% Calories from Fat (%)
Total Carbohydrate (g)	% Calories from Carbohydrate (%)
Total Protein (g)	% Calories from Protein (%)

14. Blanton, C. Moshfegh, A. Baer, D. Kretsch, M. The USDA Automated Multiple-Pass Method Accurately Estimates Group Energy and Nutrient Intake. *The Journal of Nutrition.* 136(10): 2594-2599.
15. Shackel SF. Buzzard IM, Gebhardt SE. Procedures for estimating nutrient values for food composition databases. J Food Comp and Anal. 1997; 10:102-114.

Meal Time (24-hour clock)

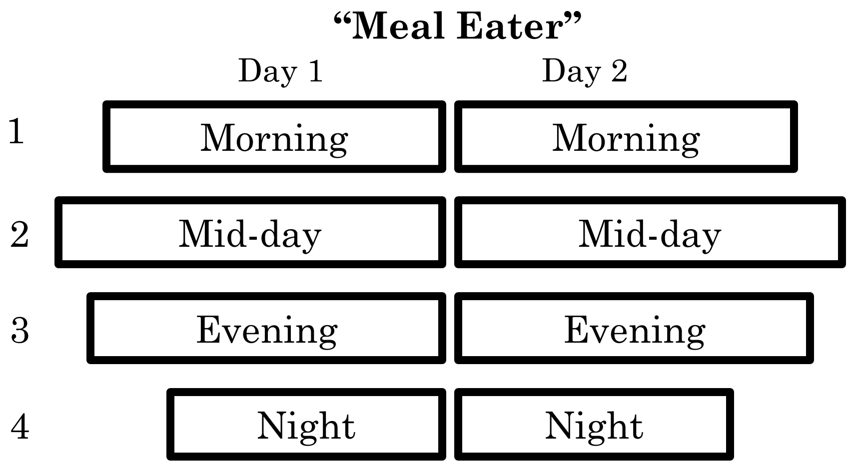
1. Time period #1; Morning (4:00am-9:59am)
2. Time period #2; Mid-day (10:00am-15:59pm)
3. Time period #3; Evening (16:00-21:59pm)
4. Time period #4; Night (22:00pm-3:59am)

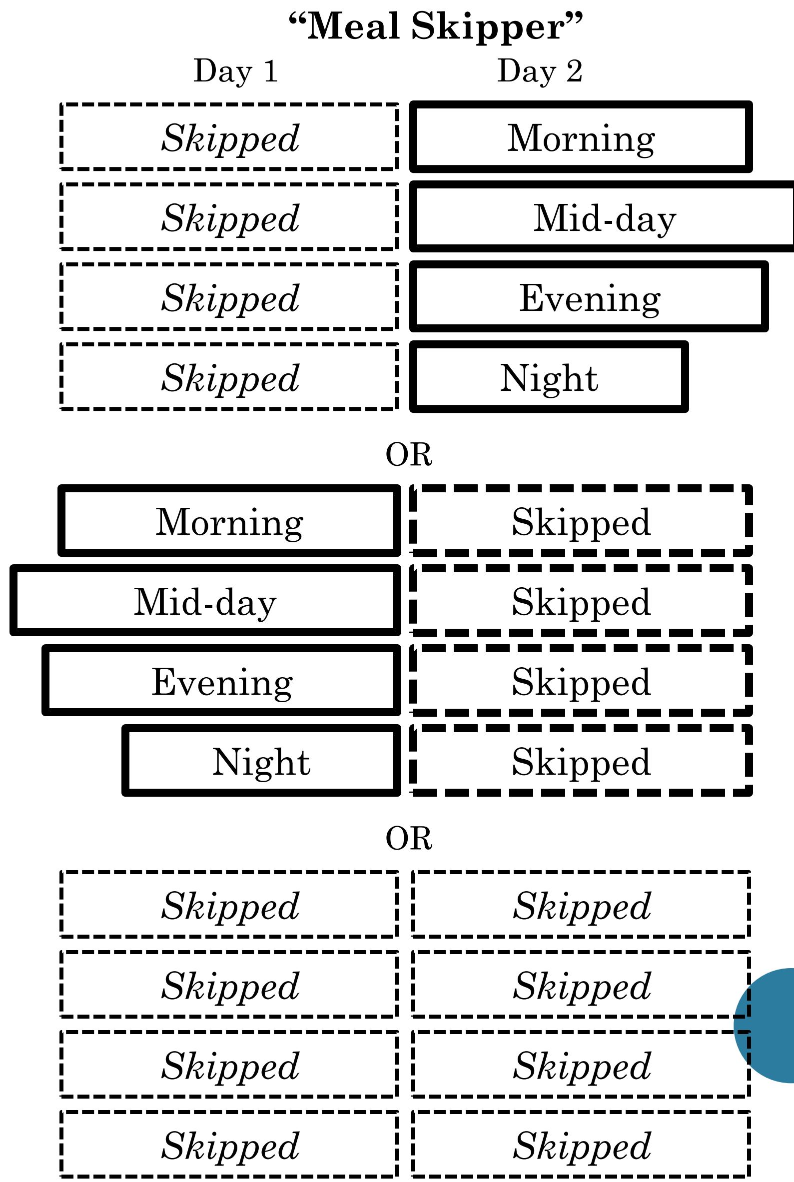
Dietary Intake Pattern

Day 1

1	Morning	Mid-day	Evening	Night	= total
2		Mid-day	Evening	Night	= total
3	Morning		Evening	Night	= total
4	Morning	Mid-day		Night	= total
5	Morning	Mid-day	Evening		= total
6		Mid-day	Evening		= total
7	Morning		Evening		= total
8	Morning	Mid-day			= total
9		Mid-day			= total

Meal Skipping Behavior





1. Time period #1; Morning (4:00am-9:59am)
2. Time period #2; Mid-day (10:00am-15:59pm)
3. Time period #3; Evening (16:00-21:59pm)
4. Time period #4; Night (22:00pm-3:59am)

Statistics

- Description of variables
  - Categorical: Frequency (%)
  - Continuous: Median (IQR)
- Primary outcome variable (HbA1c)
  - Log transformed for normality
- Dietary intake data
  - Intake: Averaged between days
  - Pattern: Described during day one
  - Meal skipping behavior: Described between two days of 24-hour dietary recall

Statistics

- Multiple regression analysis
  - Regressions run between demographic, intake, pattern data + HbA1c
    - $p<0.2$ to determine significance for regression
  - Significant variables selected for backward stepwise regression
    - $p<0.05$ to determine significance

Results

Table 1. Demographic Characteristics of Life Participants

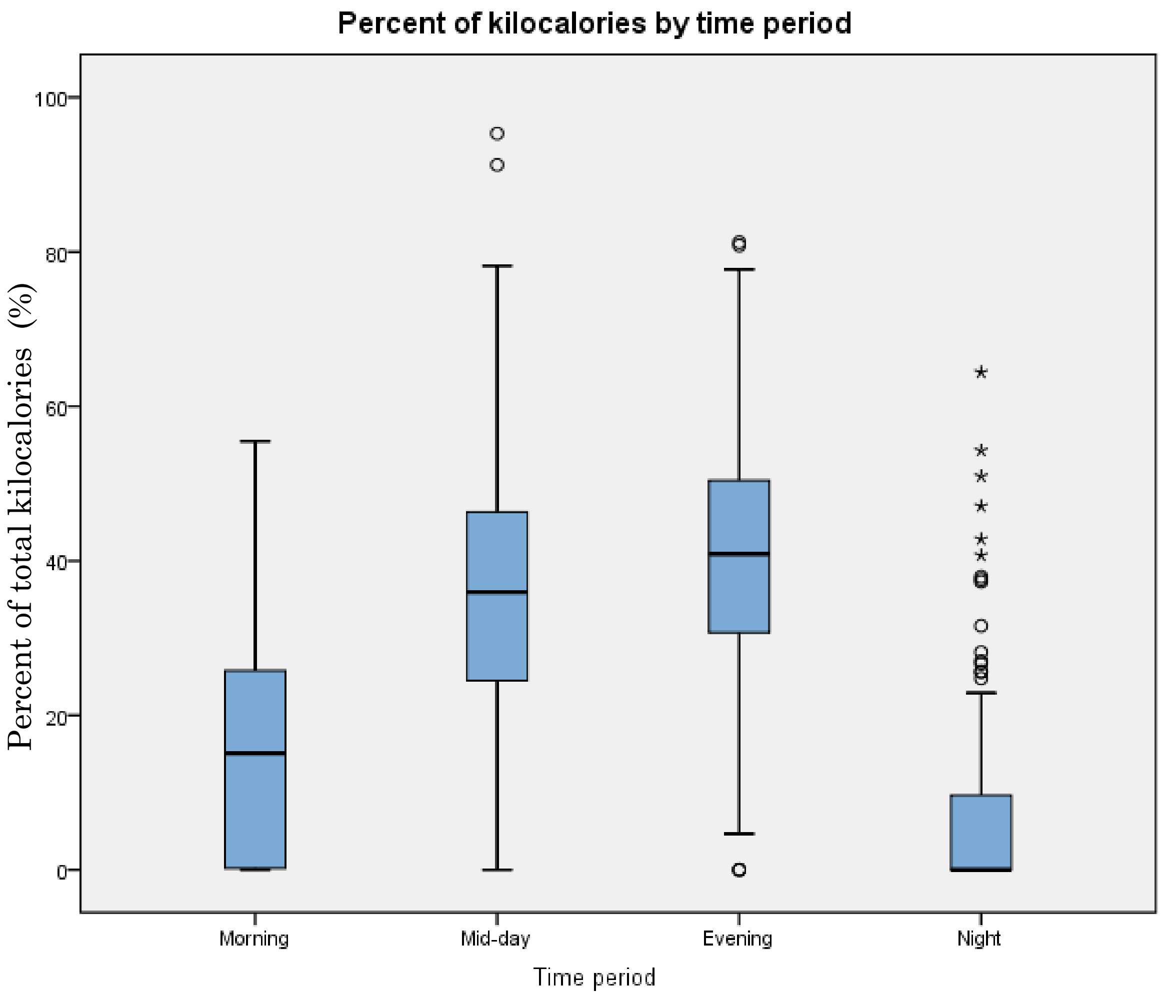
Categorical Variables	**Total Sample (n=211)**
	n (%)
Gender	
Male	63 (30)
Female	148 (70)
Education	
≤High School	97 (46)
>High School	114 (54)
Relationship status	
Single	161 (76)
Living with Partner	50 (24)
Income	
<$30,000	151 (84)
≥$30,000	29 (16)
Employment	
Employed	62 (30)
Unemployed	147 (70)
Smoker	
Yes	47 (22)
No	164 (78)
Diabetes education	
Yes	101 (48)
No	110 (52)
Medications	
None/Pills	115 (54)
Pills/Insulin	96 (45)
Moderate – vigorous activity (min)	
≤15 min	108 (51.2)
>15 min	103 (48.8)

Results

Table 1. Demographic Characteristics of Life Participants Continued

Demographic Variables	**Total Sample (n=211)**	
	Median	IQR
Hemoglobin A1c (%)	8.50	7.80, 9.80
Age (years)	56.0	50.0, 62.0
Poverty income ratio (PIR)	1.09	0.65, 1.62
Weight (kg)	95.7	83.5, 112.0
Body mass index (kg/m^2)	34.9	29.3, 39.9
Waist circumference (inches)	44.1	40.2, 47.6
Systolic blood pressure (mm Hg)	130.5	120.5, 143.5
Diastolic blood pressure (mm Hg)	81.0	74.0, 87.0
Number of comorbidities[1]	1.0	1.0, 2.0
Length of diabetes (years)	9.4	4.6, 15.3
Medication adherence (MMSA8)	6.0	3.0, 7.0
PHQ9 (Depression scale)	5.0	1.0, 9.0

[1]Comorbidities tallied; heart attack, heart failure, hypertension, stroke, renal insufficiency, retinopathy, and self-reported hypoglycemia (rate of 4-6 times per month)



	Median (IQR)
Avg % calories/morning	15.08 (0.14, 26.03)[a]
Avg % calories/mid-day	35.94 (24.45, 46.33)[b]
Avg % calories/evening	40.88 (30.67, 50.50)[c]
Avg % calories/night	0 (0, 9.66)[a]

Dietary Intake Pattern

Day 1

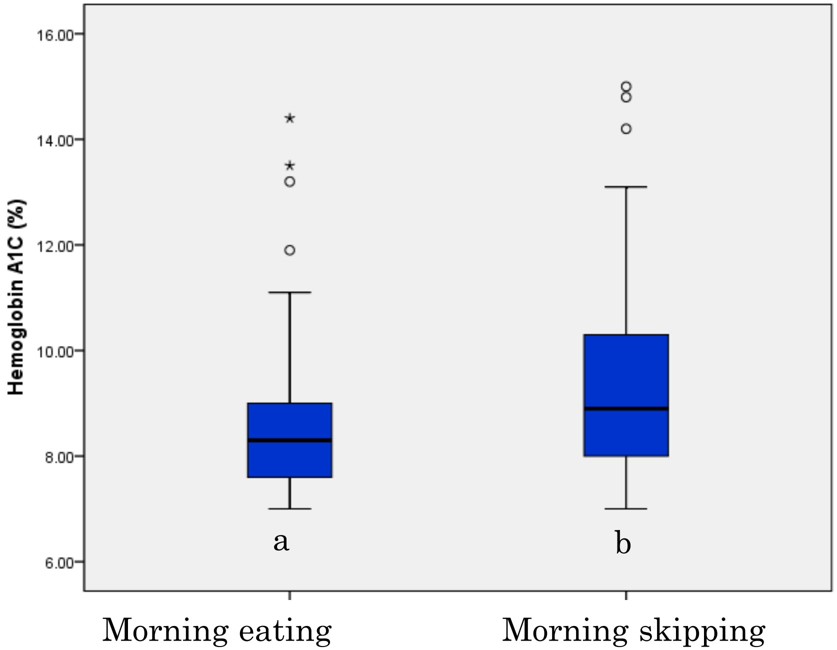
1	Morning	Mid-day	Evening	Night	= 48 (23%)
2		Mid-day	Evening	Night	= 25 (12%)
3	Morning		Evening	Night	= 1 (0.5%)
4	Morning	Mid-day		Night	=2 (1%)
5	Morning	Mid-day	Evening		= 92 (44%)
6		Mid-day	Evening		= 39 (18%)
7	Morning		Evening		= 2 (1%)
8	Morning	Mid-day			= 1 (0.5%)
9		Mid-day			= 1 (0.5%)

Dietary Intake Pattern

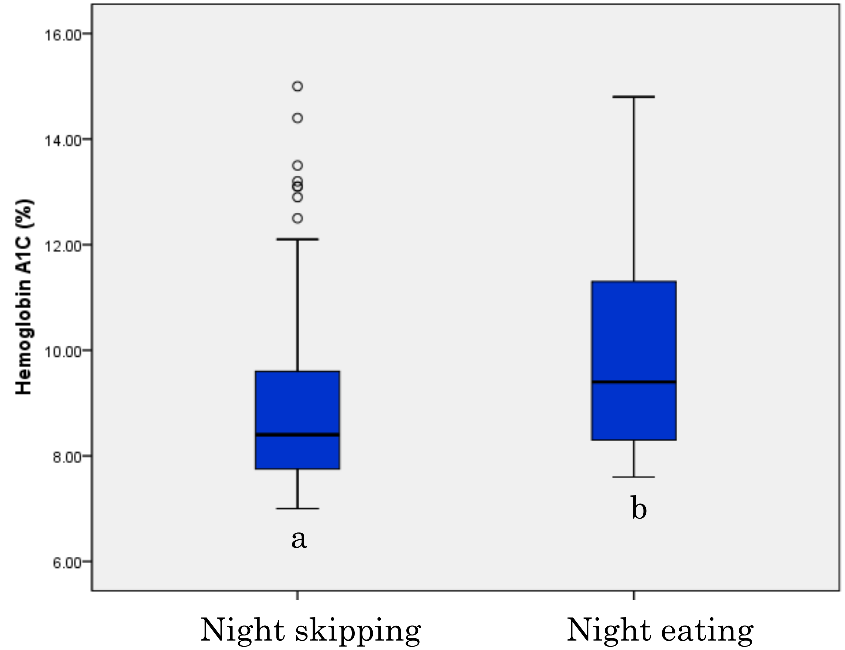
	Median (IQR)	Sig.
Pattern 1: Overnight Eaters (n=76)	8.9(8.1,10.1)[b]	0.016
Pattern 2: Daytime Eaters (n=135)	8.3(7.6,9.6)[a]	

DIETARY PATTERN AND A1C

Association between morning eating and HbA1c



Association between night eating and HbA1c



	Median (IQR)	
Morning (Time period #1)		0.002
Morning skippers	8.9 (8.0, 10.3)[a]	
Morning eater	8.3 (7.6, 9.0)[b]	
Night (Time period #4)		0.008
Night skipper	8.4 (7.7, 9.6)[a]	
Night eater	9.4 (8.3, 11.3)[b]	

Table 7. Dietary intake parameters by meal skipping behavior

Diet Characteristics	Breakfast eaters[1] (n=94)	Breakfast skippers[2] (n=116)	Sig[3]
	Median (IQR)		
Kilocalories	1764.0 (1443.8, 2264.1)[a]	1725.4 (1262.9, 2227.2)[a]	0.266
Carbohydrate (grams)	200.6 (159.3, 264.5)[a]	184.1 (142.7, 244.4)[a]	0.152
Percent kcal fat (%)	38.3 (32.5, 41.1)[a]	37.4 (32.0, 43.1)[a]	0.636
Percent kcal CHO (%)	45.0 (40.4, 52.0)[a]	45.3 (38.6, 50.7)[a]	0.519
Percent kcal protein (%)	17.0 (14.0, 19.6)[a]	17.0 (14.1, 19.7)[a]	0.931
Diet Characteristics	**Nighttime eaters[4] (n=26)**	**Nighttime skippers[5] (n=184)**	**Sig[3]**
	Median (IQR)		
Kilocalories	1827.6 (1445.1, 2486.9)[a]	1724.2 (1329.6, 2182.8)[a]	0.163
Carbohydrate (grams)	213.4 (156.9, 256.9)[a]	189.7 (147.2, 255.9)[a]	0.506
Percent kcal fat (%)	40.5 (32.3, 43.6)[a]	37.4 (32.0, 41.8)[a]	0.171
Percent kcal CHO (%)	43.2 (36.9, 50.0)[a]	45.6 (39.8, 51.6)[a]	0.133
Percent kcal protein (%)	17.4 (14.6, 19.7)[a]	16.8 (13.7, 19.6)[a]	0.629

[1]Breakfast eaters consumed food during time period #1 (4:00am-9:59am) on both days
[2]Breakfast skippers did not consume food during time period #1 (4:00am-9:59am) on either one or both days
[3] Mann-Whitney U tests performed between dietary patterns with significance at p<0.05
[4]Nighttime eaters consumed food during time period #4 (22:00pm-3:59am) on both days
[5]Nighttime skippers did not consume food during time period #4 (22:00 pm-3:59 pm) on one or both days

Table 2. Association and differences by demographic variables influencing A1c

Demographic Variables	A1c[1]	Beta	Sig[3]
	Median(IQR)		
Gender[4]		-	0.006
Male	9.2(8.0, 10.7)[a]		
Female	8.3(7.6, 9.6)[b]		
Relationship status[4]		-	
Single	8.3(7.8, 9.6)[a]		0.005
Living with Partner	9.2(8.1, 10.7)[b]		
Employment[4]		-	
Employed	8.9(7.9, 11.1)[a]		0.081
Unemployed	8.4(7.8, 9.6)[a]		
Medications[4]		-	
None/Pills	8.3(7.5, 9.5)[a]		0.007
Pills/Insulin	9.0(8.0, 10.7)[b]		
Age (years)[5]	-	-0.302	<0.001
Weight (kg)[5]	-	-0.136	0.048
Body mass index (kg/m^2)[5]	-	-0.158	0.022
Diastolic blood pressure (mm Hg)[5]	-	0.180	0.009
Number of comorbidities[5,6]	-	0.127	0.066
Medication adherence (MMSA8)[5]	-	-0.185	0.007

[1]Log transformations were performed on HbA1c values in order to normalize the distribution
[2]Unstandardized B
[3] p<0.2 was used to determine significance for regression
[4] Mann-Whitney U tests performed between categorical variables of interest and log transformed hemoglobin A1c
[5]Regressions were run between log transformed HbA1c and continuous variables of interest
[6] Comorbidities tallied; heart attack, heart failure, hypertension, stroke, renal insufficiency, retinopathy, and self-reported hypoglycemia (rate of 4-6 times per month)

Table 3. Daytime versus overnight dietary patterns: backward stepwise regression analysis predicting A1c[1] in subjects with type 2 diabetes (n=211)

Variable[2]	Beta	P value
Constant		
Gender[3]	0.119	0.057
Age	-0.241	0.001
Relationship status[4]	0.148	0.017
Diastolic blood pressure (mm Hg)	0.128	0.053
BMI (kg/m²)	-0.233	<0.001
Type of medication[5]	0.174	0.006
Medication adherence	-0.168	0.007
Percent kilocalories from fat (%)	0.117	0.063
F	9.313	<0.001
R^2, %	0.272	

[1]A1c was log-transformed for analyses

[2]Variables entered into regression analysis include: Gender, Age, Relationship status, Employment status, Diastolic blood pressure, BMI (kg/m²), Number of comorbidities, Type of medication, Medication adherence, Percent kilocalories from fat (%), and dietary intake pattern (daytime eaters vs. nighttime eaters)

[3] "Gender" was coded as 0 female and 1 male

[4] "Relationship Status" was coded as 0 single and 1 living with a partner

[5] "Type of Medication" was coded as 0 none/pills and 1 insulin

Table 4. Morning skipping behavior: backward stepwise regression analysis predicting A1c[1] in subjects with type 2 diabetes (n=211)

Variable[2]	Beta	P value
Constant		
Gender[3]	0.114	0.067
Age	-0.230	0.001
Relationship status[4]	0.149	0.016
Diastolic blood pressure (mm Hg)	0.123	0.061
BMI (kg/m²)	-0.228	<0.001
Type of medication[5]	0.162	0.010
Medication adherence	-0.154	0.014
Percent kilocalories from fat (%)	0.113	0.069
Morning skipping[6]	0.125	0.043
F	8.870	<0.001
R^2, %	0.287	

[1]A1c was log-transformed for analyses

[2]Variables entered into regression analysis include: Gender, Age, Relationship status, Employment status, Diastolic blood pressure, BMI (kg/m^2), Number of comorbidities, Type of medication, Medication adherence, Percent kilocalories from fat (%), Breakfast skipping (one/both)

[3] "Gender" was coded as 0 female and 1 male

[4] "Relationship Status" was coded as 0 single and 1 living with a partner

[5] "Type of Medication" was coded as 0 none/pills and 1 insulin

[6] "Breakfast skipping" was coded as 0 ate breakfast both days and 1 skipped breakfast one/both days

Table 5. Night eater vs. night skipper: backward stepwise regression analysis predicting A1c[1] in subjects with type 2 diabetes (n=211)

Variable[2]	Beta	P value
Constant		
Gender[3]	0.142	0.022
Age	0.290	<0.001
Relationship Status[4]	0.147	0.018
BMI (kg/m^2)	-0.201	0.002
Type of medication[5]	0.148	0.017
Medication adherence	-0.164	0.009
Night eating[6]	0.144	0.020
F	10.408	<0.001
R^2, %	0.267	

[1]A1c was log-transformed for analyses

[2]Variables entered into regression analysis include: Gender, Age, Relationship status, Employment status, Diastolic blood pressure, BMI (kg/m^2), Number of comorbidities, Type of medication, Medication adherence, Percent kilocalories from fat (%), Total kilocalories, Breakfast skipping (both), Breakfast skipping (none), Night time skipping (one), Night time skipping (neither)

[3] "Gender" was coded as 0 female and 1 male

[4] "Relationship Status" was coded as 0 single and 1 living with a partner

[5] "Type of Medication" was coded as 0 none/pills and 1 insulin

[6] "Nighttime eating" was coded as 0 did not eat overnight one/both days and 1 ate overnight both days

Discussion

- A higher A1c was associated with being
  - Younger[16,17]
  - Being on insulin[18,19,20]
  - Lower medication adherence[21]
  - Higher percent of kilocalorie intake from fat[22]

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Discussion

- A higher A1c was associated with being
  - Male[23,24,25]
  - Living with a partner[26]
  - Lower BMI[27]
  - Higher diastolic blood pressure[26,28]

23. Goudswaard AN, Stolk RP, Zuithoff P, Rutten GE. Patient characteristics do not predict poor glycaemic control in type 2 diabetes patients treated in primary care. *Eur J Epidemiol*. 2004;19(6):541-545
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Discussion

- Morning skipping pattern accounted for 29% of the variance in A1c
- Night eating pattern accounted for 27% of the variance in A1c

6. Reutrakul, S. Hood, M. Crowley, S. Morgan, M. Teodori, M. Knutson, K. Cauter, E. (2013). Chronotype is independently associated with glycemic control in type 2 diabetes. American Diabetes Association. 36(9): 2523-2529.
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Conclusion

- Factors affecting glycemic control
  - Time of meal ingestion
  - Meal skipping behavior
- More research is needed to tease out the different mechanisms behind time of meal ingestion and glycemic control

Strengths & Limitations

- Strengths
  - Timing of meals to summarize dietary intake patterns
  - Two 24-hour dietary recalls
    - Meal skipping behavior between days
    - Done face to face
  - Multiple pass method (midnight – midnight)
- Limitations
  - Two 24-hour dietary recalls
    - Meal skipping behavior between days
  - No sleep data
  - Subjects with
    - Poor glycemic control
    - Limited physical activity
    - Lack of variability of calories at different meals

Future Implications

- Research
  - Timing of meals to describe dietary intake patterns
    - Include sleep data to determine time periods
    - Tighter time periods to explore effects of "snacking" on dietary intake
    - Consistent intake described by meal skipping behavior
- Practice
  - Encourage patients to consume food during the morning and to avoid late night eating

QUESTIONS?

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