The Impact of Parental and Own Unemployment on the Health of Adolescents in Portugal: Evidence from the EpiTeen Cohort

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Abstract

Research suggests that experiences of unemployment during adolescence have negative impacts on health, but few studies have used biomarkers to detect potential subclinical changes in health not captured by self-reported measures. In this study, we examine the impact of parental and own unemployment on biomarkers and anthropometric outcomes using data from a cohort of adolescents assessed before and after the onset of the Great Recession in Portugal. Using fixed effects models to control for time-invariant confounding, we find that father's unemployment is associated with increases in triglyceride levels, fat mass, and waist to height ratio, while adolescent unemployment is associated with an increase in triglyceride levels. Sub-group analyses by sex reveal that father's unemployment has a stronger impact on females than males. Our results suggest that both parental and own unemployment during adolescence may influence health through nutrition related pathways and increase the risk of chronic disease later in life.

INTRODUCTION

Research suggests that parental job loss adversely affects adolescents' educational attainment, future earnings, and well-being.(1, 2) The detrimental effects of parental job loss are more pronounced for adolescents from low socioeconomic status households.(3) These effects also appear to be long-lasting; in a study of sons aged 17-25, reductions in well-being persisted up to five years after their fathers became unemployed.(2) Most studies examining the impact of unemployment among adolescents has focused on parental unemployment. However, research also suggests that youth unemployment has a negative impact on health.(4-7) These health impacts may be particularly prominent during economic recessions, such as the Great Recession, during which youth unemployment rates were particularly high.(8)

While there is evidence that youth unemployment negatively impacts mental health,(4, 6) there are few studies examining impacts on physical health. Biomarkers, or biochemical, molecular, or cellular indicators of subclinical or clinical disease,(9) may offer additional insight to the effects of economic recessions on physical health. Evidence suggests that subclinical disease may emerge since early in life and have long lasting implications, which highlights the importance of biomarkers as outcomes.(10, 11) Recent studies found that experiencing more economic hardship during the Great Recession was associated with higher cellular epigenetic ageing scores, higher allostatic load, worse self-rated health,(12) and higher risks of metabolic syndrome (13) among adolescents in the US. Additionally, adolescents whose families were of lower socioeconomic status before the recession and fell into poverty during the recession had higher allostatic load (12) and higher risks of metabolic syndrome (13) than adolescents whose families consistently experienced less economic hardship. These findings point to a negative impact of economic shocks on subclinical disease processes among adolescents and highlights the importance of studying the impact of parental and youth unemployment during the economic downturn.

This study examines the impact of adolescents' own experiences of unemployment as well as experiences of parental unemployment on biomarkers among adolescents during the Great Recession in Portugal, where youth unemployment was particularly high. Our measures include a wide range of inflammatory, metabolic, and cardiovascular biomarkers and anthropometric outcomes. We use longitudinal data and exploit unprecedented increases in youth unemployment which occurred during the recent financial crisis.

METHODS

Data

Data comes from 4 waves of the EpiTeen cohort study (n = 2942), based in Porto, Portugal.(14) Participants born in 1990 were recruited from public and private schools in Porto at baseline in 2003/2005 and followed up in 2006/2008 (wave 2), 2011/2013 (wave 3), and 2014/2015 (wave 4). This provided us with 2 waves prior to the onset of the financial crisis in Portugal and 2 waves after the onset of the recession. Figure 1 shows how the macroeconomic unemployment rates in Portugal changed over the course of the study, and indicates that there were increases in youth, adult, and total unemployment rates between wave 2 (2005-2008) and wave 3 (2011-2013) during the course of the Portuguese recession.

Measures of Unemployment

Unemployment was measured at every wave for fathers and mothers, and at waves 3 and 4 for the adolescents/main respondents. All unemployment variables were coded as 1 if the individual reported being unemployed and 0 otherwise. At waves 1 and 2, main respondents who were still in school were assigned a 0 for own unemployment. They were assigned a value of 0 if they were employed after leaving school and assigned a value of 1 if they reported being unemployed after leaving school.

Biomarkers and Anthropometric Outcomes

Biomarkers collected included C-reactive Protein [CRP], leukocytes, lymphocytes, total cholesterol, high density lipoprotein [HDL] cholesterol, low density lipoprotein [LDL] cholesterol, triglycerides, hemoglobin, insulin, glucose, calcium, gamma glutamyl transferase [GGT], urea, creatinine, systolic blood pressure, and diastolic blood pressure. Anthropometric outcomes included weight, waist circumference, hip circumference, fat mass percent, body mass index, waist to hip ratio, and waist to height ratio. Most outcomes were collected every wave, except LDL cholesterol, which was only collected in waves 3 and 4, and calcium, gamma glutamyl transferase, and urea, which were only collected from wave 2 onwards. Prior to analysis, outcome values were screened, and extreme outliers were removed. Additionally, CRP values greater than 10 were excluded as this is indicative of current infection rather than chronic inflammation.(15) All outcomes were log transformed for statistical analysis to reduce skewness. Table 1 provides the mean value of the biomarker and anthropometric outcomes at each wave.

Other Covariates

We controlled for the following time-varying covariates in all models: wave of measurement, main respondent's age, and whether the main respondent was still in school (0 still in school, 1 out of school). Models of own unemployment also controlled for parents' employment statuses. Additionally, we incorporated income brackets (<€500 – 1000, €1001-2000, €2001-3000, >€3000) into supplementary models restricted to waves 3 and 4.

Statistical Analysis

We used linear probability fixed effect regression models (16) to examine whether parental and own unemployment were associated with adolescents' biomarkers over the study period. Fixed effects models control for time-invariant confounders because they effectively use each individual as their own control.[13] Exploiting the longitudinal nature of the data, these models examine whether changes in unemployment during the study period are associated with changes in biomarker levels, thus controlling for permanent characteristics that vary across individuals. This is in contrast to more conventional models that compare levels of biomarkers between individuals and are subject to bias by unmeasured time-invariant characteristics such as early childhood exposures, genetic determinants or personality characteristics. All analyses were conducted in Stata, version 15.(17)

RESULTS

Further results are forthcoming. Descriptive results and results from the main fixed effects models are presented below.

Among households who participated in both waves, 4.95% (n = 85) of mothers and 3.90% of fathers (n = 67) became unemployed between Waves 1 and 2. Additionally, between Waves 2 and 3, 5.09% of mothers (n = 84) and 4.48% of fathers (n = 74) became unemployed. Between Waves 3 & 4, 2.66% of mothers (n = 27) and 2.66% of fathers (n = 27) became unemployed. Of adolescents who were employed at Wave 3, 1.61% (n = 16) were unemployed at wave 4, and in total, nearly 10% of adolescents became unemployed between Wave 3 & 4 (n = 92). Of households who had their household income bracket recorded at both Waves 3 and 4, 30.2% experienced a drop in their household income bracket, 30.7% experienced no change in income bracket, and 39.1% experienced an increase in household income bracket.

Table 3 presents results of the main models examining the association between unemployment and biomarkers. Father's unemployment was associated with increases in gamma glutamyl transferase levels, triglyceride levels, fat mass percentage, and waist to height ratio. Own unemployment was associated with increased triglyceride levels. In contrast, mother's unemployment was not associated with any biomarkers.

Table 4 and 5 present results of sub-group analyses by gender. For females, mother's unemployment was associated with an increase in CRP; father's unemployment was associated with increases in triglyceride levels, systolic blood pressure, and fat mass percent, and own unemployment was associated with an

increase in triglyceride levels (Table 4). For males, mother's unemployment was associated with a decrease in leukocytes and own unemployment was associated with an increase in triglyceride levels (Table 5).

Table 6 presents supplementary models that incorporated household income brackets measured and limits the data to waves 3 and 4 when income brackets were collected. While a change of income bracket into the €2001-3000 bracket was associated with a decrease in leukocytes, we did not find any consistent associations between changes in income brackets and biomarkers.

DISCUSSION

We examined the impact of parental and own unemployment on the physical health and healthy ageing of adolescents in Portugal using a wide range of biomarker and anthropometric outcomes. Though there were high rates of unemployment, including youth unemployment, at the national level during the study period, there were relatively few cases of unemployment among mothers, fathers, and adolescents in the study. The results of fixed effect models indicated that there were little if any effect of mother's unemployment or changes in income bracket on biomarkers. Father's unemployment appears to be associated with anthropometric outcomes, as well as triglycerides. Own unemployment was consistently associated with an increase in triglycerides.

Subgroup analyses thus far indicate that females appear to be more impacted by job loss than males, particularly in terms of father's job loss. Additionally, we found some evidence that mother's unemployment may increase levels of C-reactive protein among females, which may reflect initial signals of inflammatory pathways associated with chronic stress. The fact that we did not see this association among males, however, is puzzling, and suggests potential gender differences in the biological response to stress associated with parental unemployment.

Several limitations should be considered in interpreting these results. First, results may be biased if participants who dropped out of the study were systematically different from those who responded at each wave. For example, people who were more likely to lose their job may have been more likely to be lost to follow-up. Second, we applied a fixed effects approach to control for time-invariant confounding, and approach to estimating a causal effect of unemployment on biology. However, in this sample of Porto families, we observed only modest increase in youth and parental unemployment, which ultimately resulted in estimates with relatively large standard errors, as estimation is only performed among individuals who changed their employment status. Therefore, it may well be that the lack of an association between unemployment measures and biomarkers is due to limited statistical power. Future studies should aim to address these limitations using larger samples.

In conclusion, our results thus far suggest that unemployment during economic downturns may primarily impact adolescent health through nutrition related pathways, as effects are most consistent among lipid biomarkers and anthropometric measures. In addition, our results provide some preliminary evidence of increased C-reactive protein levels signalling a chronic stress response to mother's unemployment among girls, which may potentially contribute to increased chronic disease risk in later life. We expect further results and sensitivity analyses to shed more light on how adolescent health is impacted by parental and own unemployment during periods of economic decline.

Table 1: Mean Value of Biomarkers by Wave

	Wave				
	1	2	3	4	Total
C-reactive Protein	0.766	1.352	1.541	1.808	1.346
Leukocytes	6.308	6.508	6.684	6.53	6.518
Lymphocytes	35.826	34.892	34.18	34.119	34.739
Total Cholesterol	165.045	160.887	176.035	172.619	168.914
HDL Cholesterol	48.646	54.995	56.228	54.695	53.704
LDL Cholesterol			102.462	101.341	102.035
Triglycerides	64.828	70.148	86.746	86.255	77.053
Hemoglobin	13.707	14.145	14.009	14.128	13.996
Insulin	8.07	5.761	8.886	7.945	7.726
Glucose	84.984	84.862	83.174	85.054	84.406
Calcium		4.812	4.909	4.689	4.82
Gamma Glutamyl Transferase		17.163	19.144	19.572	18.546
Urea		29.647	29.361	29.897	29.595
Creatinine	0.743	0.86	0.767	0.786	0.79
Systolic Blood Pressure	112.858	117.128	108.753	110.036	112.881
Diastolic Blood Pressure	67.444	68.674	68.795	70.124	68.578
Weight	53.87	62.585	65.602	66.858	61.526
Waist Circumference	72.539	76.475	77.64	78.095	75.906
Hip Circumference	89.363	94.708	96.924	97.567	94.188
Fat Mass Percent	20.771	19.771	19.964	20.48	20.199
Body Mass Index	20.911	22.326	23.061	23.226	22.243
Waist to Hip Ratio	0.812	0.807	0.8	0.8	0.806
Waist to Height Ratio	0.453	0.458	0.461	0.461	0.458

Table 2: EpiTeen Sample Descriptives by Wave, values are column percentages unless otherwise specified

	Wave			
	1	2	3	4
N	2159	2499	1764	1092
Main Respondent				
Age (Mean)	13.7	16.9	21.9	24.7
Gender				
Female	51.7	51.3	51.5	50.2
Male	48.3	48.7	48.5	49.8
Student Status				
In School	100	100	65.4	34.4
Not in School	0	0	34.4	64.3
Missing	0	0	0.2	1.3
Education Level				
Primary	100	0	0	5.5
Secondary	0	0	0	29.8
Tertiary	0	0	0	63.8
Missing	0	100	100	0.9
Employment				
Employed	0	0	21.7	48.9
Unemployed	0	0	13.5	12.6
Student/Out of Labour Force	100	100	64.5	32.1
Missing	0	0	0.3	6.4
Marital Status				
Single	0	0	94.8	96
Married, divorced, other	0	0	5.2	2.6
Missing	100	100	0.1	1.5
Perception of Income				
Insufficient	0	0	7.5	2.3
Need to be careful with spending	0	0	33.7	16.6
Enough for necessities	0	0	33.3	24.2
Comfortable	0	0	24.1	16.1
Missing	100	100	1.4	40.8
Household				
Household Income Bracket				
<500	0	0	3.8	5.2
500-1000	0	0	15.9	18.5
1001-1500	0	0	19.8	15.3
1501-2000	0	0	14.2	11.3
2001-2500	0	0	10.1	5.5

2501-3000	0	0	9.4	4.4
>3000	0	0	15.2	38.5
Missing	100	100	11.6	1.4
Neighborhood Deprivation Index				
1 (least deprived)	32.6	34.3	37	0
2	9.7	11.9	13.1	0
3	13.7	14.5	15.6	0
4	14.7	15.1	14.2	0
5 (most deprived)	29	23.8	19.9	0
Missing	0.3	0.2	0.2	100
Mother				
Mother's Employment Status				
Employed	65.1	52	57.3	75.5
Unemployed	16.9	10.2	15.3	10.9
Out of Labour Force/Retired/Other	1.1	5	10.1	12.5
Missing	16.9	32.8	17.3	1
Mother's Education Level				
Primary	55.2	0	0	0
Secondary	20.1	0	0	0
Tertiary	20	0	0	0
Missing	4.7	100	100	100
Father				
Father's Employment Status				
Employed	74.8	55.5	58	81
Unemployed	2.5	5	9	10.3
Out of Labour Force/Retired/Other	1.8	4.6	9.7	6.6
Missing	20.8	34.9	23.3	2.2
Father's Education Level				
Primary	53	0	0	0
Secondary	20.6	0	0	0
Tertiary	18.2	0	0	0
Missing	8.2	100	100	100

Table 3: Fixed Effect Models: Association Between Unemployment and Biomarkers, EpiTeen (Waves 1 - 4)

	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
	C-reactive Protein	Leukocytes	Lymphocytes	Hemoglobin
Mother unemployed	0.017 (-0.137,0.171)	-0.006 (-0.031,0.019)	0.028 (-0.006,0.061)	0.001 (-0.007,0.009)
Father unemployed	0.079 (-0.112,0.269)	0.023 (-0.009,0.054)	-0.011 (-0.050,0.028)	0.002 (-0.007,0.011)
Adolescent unemployed	-0.098 (-0.299,0.103)	0.019 (-0.019,0.056)	0.033 (-0.008,0.073)	-0.007 (-0.017,0.003)
	Total Cholesterol	HDL Cholesterol	LDL Cholesterol	Triglycerides
Mother unemployed	-0.004 (-0.021,0.014)	0.006 (-0.016,0.029)	-0.022 (-0.063,0.019)	0.031 (-0.013,0.075)
Father unemployed	0.021 (-0.002,0.044)	0.008 (-0.023,0.038)	0.021 (-0.026,0.069)	**0.059 (0.003,0.115)***
Adolescent unemployed	0.008 (-0.016,0.032)	-0.008 (-0.038,0.022)	0.006 (-0.039,0.050)	**0.149 (0.083,0.215)*****
	Calcium	Glucose	Insulin	GGT
Mother unemployed	0.005 (-0.002,0.012)	0.001 (-0.014,0.015)	-0.009 (-0.086,0.069)	-0.007 (-0.055,0.042)
Father unemployed	0.004 (-0.004,0.011)	0.017 (-0.001,0.036)	0.096 (-0.010,0.201)	**0.059 (0.012,0.106)***
Adolescent unemployed	0.003 (-0.005,0.010)	0.002 (-0.014,0.018)	-0.014 (-0.119,0.091)	0.012 (-0.041,0.065)
	Urea	Creatinine	SBP	DBP
Mother unemployed	-0.002 (-0.031,0.028)	0.010 (-0.008,0.028)	0.005 (-0.005,0.014)	-0.007 (-0.019,0.005)
Father unemployed	-0.010 (-0.045,0.024)	0.011 (-0.012,0.034)	0.011 (-0.000,0.022)	0.005 (-0.010,0.021)
Adolescent unemployed	-0.033 (-0.073,0.006)	-0.008 (-0.034,0.018)	-0.002 (-0.015,0.012)	0.004 (-0.012,0.020)
	Weight	Waist Circumference	Hip Circumference	Fat Mass Percent
Mother unemployed	-0.002 (-0.013,0.010)	-0.002 (-0.010,0.006)	-0.002 (-0.007,0.004)	0.010 (-0.019,0.038)
Father unemployed	0.008 (-0.006,0.022)	0.010 (-0.000,0.020)	0.004 (-0.003,0.011)	**0.055 (0.025,0.085)*****
Adolescent unemployed	-0.008 (-0.024,0.007)	-0.005 (-0.017,0.007)	-0.004 (-0.012,0.005)	-0.024 (-0.069,0.021)
	Body Mass Index	Waist to Hip Ratio	Waist to Height Ratio	
Mother unemployed	-0.002 (-0.011,0.006)	-0.000 (-0.007,0.006)	-0.002 (-0.010,0.005)	
Father unemployed	0.010 (-0.001,0.021)	0.006 (-0.003,0.014)	**0.010 (0.001,0.020)***	
Adolescent unemployed	-0.007 (-0.020,0.007)	-0.001 (-0.010,0.008)	-0.004 (-0.016,0.008)	

* p<0.05, ** p<0.01, *** p<0.001; All models control for mother's employment, father's employment, whether the participant is currently in school, the participant's employment status, age, and wave of interview; All outcomes are log transformed

Table 4: Fixed Effect Models: Association Between Unemployment and Biomarkers for Females, EpiTeen (Waves 1 - 4)

	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
	C-reactive Protein	Leukocytes	Lymphocytes	Hemoglobin
Mother unemployed	**0.197 (0.003,0.391)***	0.015 (-0.018,0.048)	0.025 (-0.020,0.070)	0.003 (-0.006,0.013)
Father unemployed	-0.036 (-0.285,0.212)	0.021 (-0.023,0.065)	-0.010 (-0.065,0.045)	0.006 (-0.005,0.018)
Adolescent unemployed	-0.083 (-0.339,0.173)	0.012 (-0.040,0.064)	0.027 (-0.032,0.086)	-0.005 (-0.018,0.009)
	Total Cholesterol	HDL Cholesterol	LDL Cholesterol	Triglycerides
Mother unemployed	-0.002 (-0.025,0.021)	0.004 (-0.026,0.034)	0.003 (-0.043,0.050)	0.040 (-0.021,0.102)
Father unemployed	0.026 (-0.005,0.056)	0.020 (-0.020,0.061)	0.018 (-0.042,0.078)	**0.109 (0.029,0.190)****
Adolescent unemployed	0.009 (-0.021,0.039)	-0.000 (-0.041,0.040)	0.002 (-0.055,0.059)	**0.156 (0.064,0.249)*****
	Calcium	Glucose	Insulin	GGT
Mother unemployed	0.004 (-0.005,0.013)	0.004 (-0.016,0.024)	0.030 (-0.062,0.122)	0.034 (-0.024,0.092)
Father unemployed	0.007 (-0.002,0.017)	0.021 (-0.003,0.044)	0.106 (-0.033,0.245)	0.041 (-0.014,0.095)
Adolescent unemployed	0.002 (-0.008,0.011)	-0.004 (-0.026,0.019)	-0.048 (-0.174,0.078)	0.026 (-0.039,0.091)
	Urea	Creatinine	Systolic Blood Pressure	Diastolic Blood Pressure
Mother unemployed	0.014 (-0.024,0.052)	0.016 (-0.007,0.039)	0.005 (-0.006,0.017)	-0.012 (-0.029,0.004)
Father unemployed	-0.000 (-0.044,0.043)	0.027 (-0.005,0.059)	**0.014 (0.001,0.027)***	0.006 (-0.014,0.025)
Adolescent unemployed	-0.053 (-0.108,0.002)	-0.013 (-0.047,0.020)	0.006 (-0.010,0.022)	0.011 (-0.010,0.032)
	Weight	Waist Circumference	Hip Circumference	Fat Mass Percent
Mother unemployed	-0.002 (-0.013,0.008)	-0.002 (-0.011,0.007)	-0.002 (-0.008,0.004)	0.012 (-0.019,0.042)
Father unemployed	0.012 (-0.003,0.027)	0.011 (-0.002,0.024)	0.005 (-0.004,0.015)	**0.060 (0.026,0.095)*****
Adolescent unemployed	-0.001 (-0.019,0.018)	0.002 (-0.013,0.017)	-0.000 (-0.010,0.010)	0.009 (-0.045,0.063)
	Body Mass Index	Waist to Hip Ratio	Waist to Height Ratio	
Mother unemployed	-0.001 (-0.011,0.009)	-0.000 (-0.008,0.007)	-0.001 (-0.010,0.008)	
Father unemployed	0.012 (-0.003,0.026)	0.005 (-0.006,0.017)	0.010 (-0.003,0.024)	
Adolescent unemployed	-0.000 (-0.018,0.018)	0.002 (-0.009,0.013)	0.003 (-0.012,0.018)	

* p<0.05, ** p<0.01, *** p<0.001; All models control for mother's employment, father's employment, whether the participant is currently in school, the participant's employment status, age, and wave of interview; All outcomes are log transformed

Table 5: Fixed Effect Models: Association Between Unemployment and Biomarkers for Males, EpiTeen (Waves 1 - 4)

	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
	C-reactive Protein	Leukocytes	Lymphocytes	Hemoglobin
Mother unemployed	-0.192 (-0.413,0.030)	**-0.039 (-0.077,-0.001)***	0.039 (-0.014,0.091)	-0.006 (-0.016,0.003)
Father unemployed	0.237 (-0.045,0.520)	0.026 (-0.016,0.069)	-0.007 (-0.058,0.044)	-0.001 (-0.012,0.010)
Adolescent unemployed	-0.089 (-0.384,0.207)	0.035 (-0.018,0.088)	0.035 (-0.016,0.085)	-0.005 (-0.018,0.008)
	Total Cholesterol	HDL Cholesterol	LDL Cholesterol	Triglycerides
Mother unemployed	-0.006 (-0.033,0.022)	0.014 (-0.017,0.046)	-0.057 (-0.128,0.015)	0.018 (-0.045,0.082)
Father unemployed	0.007 (-0.027,0.041)	-0.012 (-0.054,0.030)	0.014 (-0.059,0.086)	-0.014 (-0.087,0.058)
Adolescent unemployed	0.009 (-0.030,0.049)	-0.023 (-0.063,0.017)	0.016 (-0.052,0.084)	**0.142 (0.052,0.232)****
	Calcium	Insulin	Glucose	GGT
Mother unemployed	0.006 (-0.005,0.017)	-0.072 (-0.204,0.060)	-0.005 (-0.025,0.014)	-0.072 (-0.151,0.007)
Father unemployed	-0.004 (-0.015,0.008)	0.081 (-0.079,0.242)	0.012 (-0.020,0.043)	0.080 (-0.000,0.160)
Adolescent unemployed	0.006 (-0.006,0.019)	0.039 (-0.143,0.220)	0.012 (-0.009,0.034)	0.010 (-0.077,0.098)
	Urea	Creatinine	Systolic Blood Pressure	Diastolic Blood Pressure
Mother unemployed	-0.029 (-0.077,0.019)	-0.002 (-0.024,0.020)	0.004 (-0.011,0.018)	-0.000 (-0.018,0.018)
Father unemployed	-0.039 (-0.091,0.014)	-0.011 (-0.040,0.017)	0.007 (-0.012,0.025)	0.008 (-0.016,0.032)
Adolescent unemployed	0.006 (-0.047,0.060)	0.012 (-0.020,0.043)	-0.007 (-0.026,0.013)	-0.006 (-0.032,0.020)
	Weight	Waist Circumference	Hip Circumference	Fat Mass Percent
Mother unemployed	-0.004 (-0.022,0.014)	-0.003 (-0.015,0.009)	-0.001 (-0.011,0.008)	0.009 (-0.043,0.062)
Father unemployed	0.005 (-0.016,0.025)	0.006 (-0.008,0.020)	0.003 (-0.007,0.013)	0.037 (-0.016,0.090)
Adolescent unemployed	-0.014 (-0.039,0.010)	-0.011 (-0.029,0.008)	-0.008 (-0.022,0.006)	-0.059 (-0.134,0.016)
	Body Mass Index	Waist to Hip Ratio	Waist to Height Ratio	
Mother unemployed	-0.004 (-0.019,0.010)	-0.002 (-0.011,0.008)	-0.004 (-0.016,0.009)	
Father unemployed	0.006 (-0.010,0.022)	0.003 (-0.006,0.012)	0.007 (-0.007,0.021)	
Adolescent unemployed	-0.013 (-0.034,0.009)	-0.002 (-0.015,0.010)	-0.010 (-0.028,0.009)	

* p<0.05, ** p<0.01, *** p<0.001; All models control for mother's employment, father's employment, whether the participant is currently in school, the participant's employment status, age, and wave of interview; All outcomes are log transformed

Table 6: Fixed Effect Models: Association Between Income Brackets and Biomarkers, EpiTeen (Waves 3 - 4)

	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Income Bracket[+]	C-reactive Protein	Leukocytes	Lymphocytes	Hemoglobin
€1001-2000	-0.151 (-0.371,0.070)	-0.025 (-0.062,0.011)	0.020 (-0.021,0.061)	0.001 (-0.008,0.011)
€2001-3000	-0.135 (-0.406,0.136)	**-0.054 (-0.102,-0.007)***	0.020 (-0.028,0.069)	-0.006 (-0.019,0.006)
>€3000	0.077 (-0.171,0.326)	-0.041 (-0.088,0.006)	-0.010 (-0.058,0.038)	0.002 (-0.011,0.015)
	Total Cholesterol	HDL Cholesterol	LDL Cholesterol	Triglycerides
€1001-2000	-0.002 (-0.028,0.023)	0.002 (-0.024,0.029)	-0.003 (-0.036,0.030)	-0.023 (-0.089,0.042)
€2001-3000	-0.030 (-0.060,0.000)	-0.007 (-0.039,0.026)	-0.042 (-0.084,0.000)	-0.036 (-0.115,0.044)
>€3000	-0.008 (-0.037,0.021)	0.003 (-0.026,0.031)	-0.018 (-0.058,0.022)	-0.016 (-0.092,0.060)
	Calcium	Insulin	Glucose	GGT
€1001-2000	0.002 (-0.006,0.010)	-0.033 (-0.123,0.056)	-0.010 (-0.023,0.004)	0.021 (-0.034,0.077)
€2001-3000	-0.006 (-0.016,0.004)	-0.012 (-0.117,0.094)	-0.001 (-0.018,0.016)	-0.013 (-0.086,0.059)
>€3000	0.002 (-0.008,0.012)	-0.017 (-0.119,0.084)	-0.001 (-0.016,0.015)	0.015 (-0.054,0.084)
	Urea	Creatinine	Systolic Blood Pressure	Diastolic Blood Pressure
€1001-2000	0.010 (-0.029,0.050)	-0.005 (-0.026,0.016)	0.008 (-0.005,0.021)	0.007 (-0.010,0.023)
€2001-3000	-0.036 (-0.082,0.011)	0.003 (-0.023,0.029)	0.006 (-0.011,0.024)	0.006 (-0.014,0.026)
>€3000	-0.008 (-0.053,0.036)	-0.009 (-0.035,0.016)	0.008 (-0.007,0.023)	0.000 (-0.018,0.019)
	Weight	Waist Circumference	Hip Circumference	Fat Mass Percent
€1001-2000	0.006 (-0.006,0.018)	0.003 (-0.007,0.013)	0.005 (-0.002,0.012)	-0.007 (-0.046,0.031)
€2001-3000	0.003 (-0.013,0.019)	-0.005 (-0.018,0.008)	-0.000 (-0.009,0.009)	-0.011 (-0.057,0.034)
>€3000	0.004 (-0.010,0.018)	0.001 (-0.011,0.013)	-0.001 (-0.010,0.008)	-0.007 (-0.053,0.038)
	Body Mass Index	Waist to Hip Ratio	Waist to Height Ratio	
€1001-2000	0.005 (-0.007,0.017)	-0.002 (-0.010,0.005)	0.002 (-0.008,0.012)	
€2001-3000	0.002 (-0.013,0.018)	-0.005 (-0.014,0.004)	-0.006 (-0.019,0.008)	
>€3000	0.004 (-0.010,0.018)	0.002 (-0.007,0.011)	0.001 (-0.011,0.013)	

* p<0.05, ** p<0.01, *** p<0.001; [+]Base level for income bracket is <€500-1000; All models control for household income bracket mother's employment, father's employment, whether the participant is currently in school, the participant's employment status, age, and wave of interview; All outcomes are log transformed

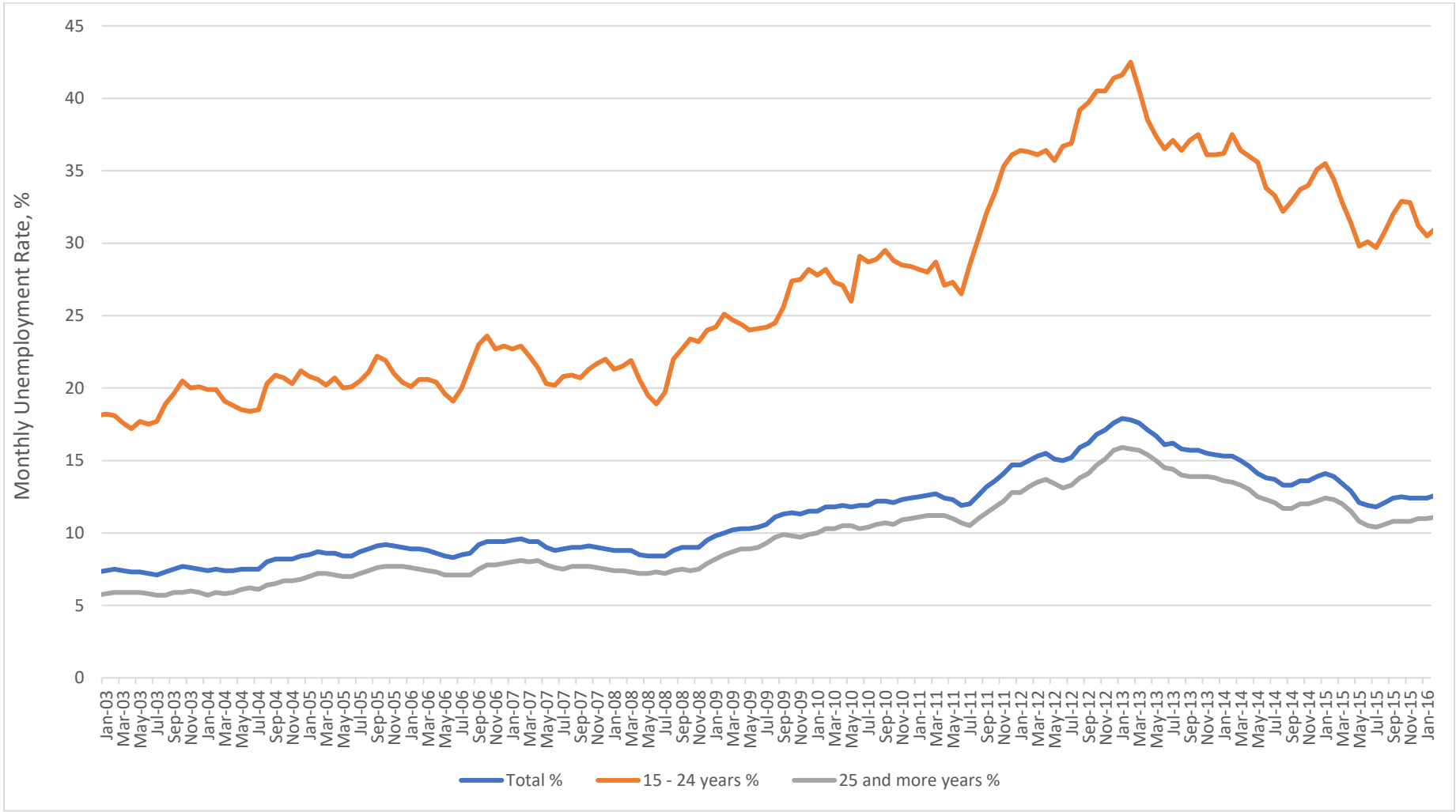

Figure 1: Monthly Unemployment Rate Among Active Population in Portugal, By Age Group
Data from Statistics Portugal, Labour Force Survey. This graph shows the monthly unemployment rate among the active population aged 15 to 74, by age group between baseline (2003-2004), wave 2 (2006-2008), wave 3 (2011-2013), and wave 4 (2014-2015) in EpiTeen.

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