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Contact Address:
University of Innsbruck
Department of Public Finance
Universitaetsstrasse 15
A-6020 Innsbruck
Austria
Tel: + 43 512 507 7171
Fax: + 43 512 507 2970
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Atypical Employment and Health: A Meta-Analysis

Alice Sanwald* Engelbert Theurl**

Abstract

In this meta-analysis we provide new quantitative evidence on the relationship between the characteristics of working contracts and worker's health. We examine 52 studies covering 26 countries in the time period 1984 - 2010 with a combined sample size of 192. We apply a random effects model using odds ratios and their 95% confidence intervals as measures for the effect size. We distinguish between six types of employment contracts with decreasing security levels (fixed-term, temporary, casual, on-call, daily, no formal contract) and classify the health outcomes into five subgroups (sickness absence, occupational injuries, health-related behavior, mental health and physical health). Furthermore, we control for selected dimensions of the socioeconomic environment of the studies, e.g. the unemployment rate and GDP growth rate. Summary findings show a higher risk of occupational injuries for atypical employees compared to the reference group. Atypical employment increases complaints about mental and physical health and has a negative impact on health-related behavior. Sickness absence works in the opposite direction and permanent employees are more likely to be absent from work. The heterogeneity of the effect sizes between different contracts of atypical employment is low. Effect sizes are country specific and depend on the health outcome indicators. The macroeconomic surrounding - unemployment rate and GDP growth rate - don't cause variation in study results. The 'healthy worker effect' may lead to an overestimation of the impact of workers' atypical employment contract on the health status. More research work which explicitly focuses on the problems of endogeneity, reverse causality and the selection bias is necessary. Furthermore, additional control groups and the employment biography of workers have to be taken into account.

JEL Classification: I1, J3, J5.

Keywords: Meta-Analysis, Atypical Employment, Health Outcomes, Employment Contracts.

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*University of Innsbruck, Department of Economics and Statistics, Universitätsstrasse 15, A-6020 Innsbruck, Austria: E-Mail: Alice.Sanwald@uibk.ac.at

**University of Innsbruck, Department of Economics and Statistics, Universitätsstrasse 15, A-6020 Innsbruck, Austria, E-Mail: Engelbert.Theurl@uibk.ac.at

1 Introduction

In this paper we provide new quantitative evidence on the relationship between different forms of atypical employment and the health status of workers. In a meta-analysis we examine 52 studies covering 26 countries in the time period 1984 - 2010.

Atypical employment in its different manifestations - fixed-term contracts, temporary agency work, contracts for a specific task, on-call work, replacement contracts and seasonal work - is an important feature of modern labor markets. OECD-sources report an increasing share of atypical employment on total dependent employment in the time period 1985 - 2012 in an unweighted OECD-average (OECD, 2002, 2013). In 2012 this share amounts at 11.8 %. However, this overall figure masks important differences in the empirical pattern. States differ widely in their share of atypical employment (3.7 % in Estonia, 26.9 % in Poland) and the share is strongly correlated with age (24.5 % in age group 15-24, 9.8 % in age group 25-54). The overall increase in the share of atypical employment is the result of very controversial developments within the OECD-states (OECD, 2002, 2013).

In contrast to its increasing empirical significance, research evidence on the consequences of atypical employment on the health status is comparably new. It is scattered in different fields of social sciences and systematic overviews on the results are quite rare. Quinlan et al. (2001) present a review study on occupational health in precarious employment situations of restructuring and downsizing of firms and organizations. The first systematic meta-analysis on the association between temporary employment and health was done by Virtanen et al. (2005a). They focus on papers published in international journals dealing with temporary employment and morbidity/mortality in the European Union, USA and Israel. In the end they select 27 studies covering data in the time period 1979 - 2001. Their review reveals higher psychological morbidity and lower sickness absences among temporary employees compared to permanent workers. Morbidity increases with the degree of instability of the employment contract, the share of temporary employees and the unemployment rate within a country. The study also points to serious methodological problems and limitations of the empirical work, e.g. dominance of cross-sectional analysis, missing controls for confounding factors, retrospective character of some studies, limited generalizability of the results, healthy worker effects and urgently recommends additional research (Virtanen et al., 2005a). More recently, Ferrie et al. (2008) present a more narrative literature review. Covering research published over the period 1970 - 2005, they study the effect of flexible labor markets on the health of employees and concentrate on the three phenomena of firm downsizing, job insecurity and temporary working arrangements. While previous work perceived these changes as separate exposures, their review indicates that they are closely interlinked and represent overlapping characteristics of the new flexible labor market. So employees engaged on a temporary contract basis are

the first ones who lose their job when firms have to downsize and many new employees will have short-term contracts after the downsizing process is finished. Overall, Ferrie et al. (2008) find strong evidence for the negative effects of downsizing and job insecurity on self-reported physical health, the rate of workplace injuries and accidents and mental health. The empirical evidence of the effects of these contextual factors on biomedical risk factors (blood pressure, BMI) and premature mortality is unclear. The same holds for the effect of temporary work where the effects on self-reported health and biomedical risk factors are mixed.

In a narrative synthesis Joyce et al. (2010) evaluate the effects of flexible working conditions (contractual, spatial, temporal) on the physical, mental and general health and wellbeing of employees and their families. Only ten studies fulfill the inclusion criteria. Their findings tentatively suggest a split in the effects. If flexible working arrangements increase the control and choice of employees, then there exists a positive effect on health. Working arrangements that were primarily motivated by organizational interests are bad for health. Joyce et al. (2010) state a substantial need for more well-defined intervention studies in this field.

For our meta-analysis we use the 'Virtanen-study' as a starting point. We concentrate on the morbidity aspect of atypical employment and extend the existing empirical knowledge in several directions. We include additional countries and continents in our sample. Compared with the 'Virtanen-study' we use information from more recent studies and additional indicators for the health outcomes. Finally, we extend the analysis by including additional forms of atypical employment. The remainder of the paper is organized in the following way. The next section describes the process of literature selection and the statistical methods applied. Then we present the results, discuss them and point to several limitations of our study. A short summary concludes the paper.

2 Methods

2.1 Literature Selection

We use the electronic databases EconLit, PubMed, SocIndex, SSCI, Medline, ERIC and PsycINFO to identify relevant reports of atypical employment and health complaints. Contract-related search terms are *'temporary, fixed-term, on-call, casual, seasonal, atypical, non-permanent, flexible, precarious and contingent'*. As an indicator of the health status we use the following keywords: *'health, pain, morbidity, stress, job insecurity, fatigue, sickness absence, psychological disorders, overwork, pressure, work inability, depression, self-rated health and occupational injuries'*. In addition, we compile a list of journals that might include relevant articles. We clarify that all of them are part of the electronic search. Individual websites of the *American Journal of Epidemiology, Epidemiology, European*

Journal of Epidemiology, International Journal of Epidemiology, Journal of Epidemiology and Community Health, Occupational & Environmental Medicine and *Occupational Medicine* are scanned and appropriate studies extracted. We manually search in reference lists of eligible articles and previous reviews of Virtanen et al. (2005a) and Joyce et al. (2010). The literature search is complemented by cross-referencing until no further study could be determined. We finished the literature search in the end of March 2012.

2.2 Inclusion & Exclusion Criteria and Operationalizations

Only empirical and peer-reviewed studies using permanent and full-time employment as reference group are included. We accept reports published in English with a sample size of at least 100 observations. The time period covered is 1984 - 2010. The exclusion of non-English studies has little impact on summary treatment effect estimates and shows no obvious evidence of publication bias due to language restrictions (Jüni et al., 2002; Moher et al., 2000; Morrison et al., 2012). However, the exclusion leads to a reduced number of retrieved studies.

We classify permanent, full-time employment as reference group for all forms of atypical employment and order six different types of atypical employment contracts according to the criterion of decreasing job security: fixed-term, temporary, casual, on-call, daily and no formal contract. One study considers employees on a project basis as individual subgroup (Amuedo-Dorantes, 2001). For lack of further studies with an identical definition, we regard project employees as employee with a fixed time period until the contract ends. Part-time employees, sub-contractors and small employers cannot be assigned to any definition of atypical employment contract exclusively. To reduce the risk of overlapping definitions of atypical employment contracts we exclude studies which use these employment categories. Reports predicting health outcomes based on mixed atypical employment contracts are separated and used as robustness check. 'Mixed contracts' refer to the combination of two or more contract types within one contract group. Furthermore, we study a normal working population and exclude specific working and firm situations e.g. shift work, health effects after insourcing, outsourcing or downsizing of firms, time-rated versus piece-rated work, unionized versus non-unionized labor and effects of changes in the employment status. We also exclude studies which specifically deal with disabled employees or ethnic minorities.

The health outcomes observed in the studies are separated into five subgroups: sickness absences, occupational injuries, health-related behavior, physical and mental health complaints. The last two groups mentioned encompass several health complaints. Self-rated health, pain, fatigue and chronic diseases are classified as physical health. Mental health includes self-rated mental health, psychological distress, depression and psychological symptoms. Broader characterizations of individual well-being such as life or job sat-

isfaction, anxiety about job insecurity, work-life conflict, job-exhaustion and job-induced tension are regarded as subjective feelings that could affect the health status. However, the directions of the effects on health outcomes are not necessarily unique and could either improve or damage health. An exact assignment of the effects to our predefined health outcomes is impossible, because they either affect physical health or mental health or combinations of both (Hämmig et al., 2009; Lau and Knardahl, 2008; Cheng et al., 2005). Outcomes based on these characteristics, organizational commitment and mortality are excluded, too.

2.3 Statistical Methods

The majority of studies report odds ratios (OR) with their 95 % confidence interval. We use this information as indicator for the effect size. The results of studies reporting effects by using other indicators (e.g. risk ratio, incidence rates, correlation coefficients, etc.) are converted into odds ratios following the standard procedures offered in the literature (Borenstein et al., 2011; Chinn, 2000; Pearce, 1993; Zocchetti et al., 1997).

Some studies report odds ratios which are adjusted for several characteristics e.g. sex, age, income, marital status and occupational status. To improve the homogeneity of the included effect sizes we prefer crude odds ratios over adjusted ones. If reports present both descriptive statistics and odds ratios we use the descriptive data to calculate odds ratios. In case that our results deviate from the effects in the original papers we analyze the reasons. To reduce the risk of double counting and overestimation of the summary effect we use baseline outcomes, if results from more observation periods are available. If reports use the same study several times, only one outcome is included in the meta-analysis. Reports offering separate results for men and women, varying age groups, different atypical employment contracts or health outcomes are considered as separate studies and included.

High heterogeneity in measured outcomes, contract types and effect sizes disposes us to apply a random effects model. It allows for variations of the true effect size across studies assuming a normal distribution. The included effect sizes represent a random sample of all effect sizes which could have been observed (Borenstein et al., 2011). The meta-analysis and meta-regression is done in Stata 12.1.

To test for heterogeneity in the magnitude of the effect we use Cochran's Q statistic (Higgins et al., 2003). A p-value of < 0.05 is considered to reject the null hypothesis that all studies share common effect size. Determination of the degree of inconsistency among the included studies is done by the I^2 statistic. It defines the percentage of total variation that is expected by heterogeneity rather than by chance (Borenstein et al., 2011; Higgins et al., 2003). Values of I^2 range between 0 % and 100 %. Benchmarks in the order of 25 %, 50 % and 75 % indicate low, moderate and high heterogeneity.

Publication bias is tested by checking for funnel plot asymmetry. In funnel plots the estimates of the effect sizes will be plotted on the horizontal axis against a measure of precision on the vertical axis (Richard and Pillemer, 1984). In the absence of publication bias the scatter plot should resemble a symmetrical inverted funnel with effect sizes from smaller studies being more widely scattered at the bottom of the funnel while larger studies with increasing precisions show a narrowing spread. If smaller studies without statistically significant effect sizes remain unpublished the funnel plot will often appear skewed and asymmetrical which represents publication bias (Egger and Smith, 1995; Egger et al., 1997; Sterne and Egger, 2001). Funnel plot asymmetry will be examined by following the methods proposed by Egger et al. (1997). Egger's linear regression test checks for 'small-study effects' which is defined as a trend for smaller studies to show larger treatment effects in a meta-analysis. If these effects are present, a relationship between the effect size and its standard errors will occur and lead to an asymmetrical appearance of the funnel plot. This may cause publication bias (Sterne et al., 2000). However, small study effects may also result from other reasons (Egger et al., 1997). A correlation between the odds ratio and the standard error of log-odds ratio can create asymmetric looking funnel plots even in the absence of small-study effects which increases the chance of false-positive test results (Irwig et al., 1998). Rosenthal's fail-safe N is used to identify the importance of any given publication bias. The number of missing studies with zero effect size is calculated by using the standard formula (Wolf, 1986).

In the meta-regression we test for different sources of heterogeneity between the studies. We check whether regional differences, the macroeconomic situation, the degree of instability of the employment contracts, study specific characteristics or different health outcomes drive findings. The included study characteristics cover different data gathering and estimation methods. We also control for the statistical significance of the included effect sizes to reduce the probability of a 'time lag bias' which might occur, if statistical insignificant results are published with delay. To control for the mentioned covariates we use two different specifications. Model 1 uses fixed-term employment as reference group for all other atypical contracts which displays the decreasing job security levels. Furthermore, sickness absence was used as reference group for the remaining health outcomes. However, sickness absence might be associated with reemployment possibilities, fear of job loss and/or adverse working conditions. On the other side, it might not display the disease pattern of employees, but the absence is affected due to the care of close relatives/friends or other reasons. Model 2 treats sickness absence as special case and excludes it from the regression while physical health acts as the new reference group. We also control for study and effect size characteristics in both models. To determine the effects of differing economic and institutional conditions we concentrate on country specific information. We control for OECD's and ILO's national unemployment rate and World Bank's GDP annual growth rates during the data collection periods of the retrieved studies.

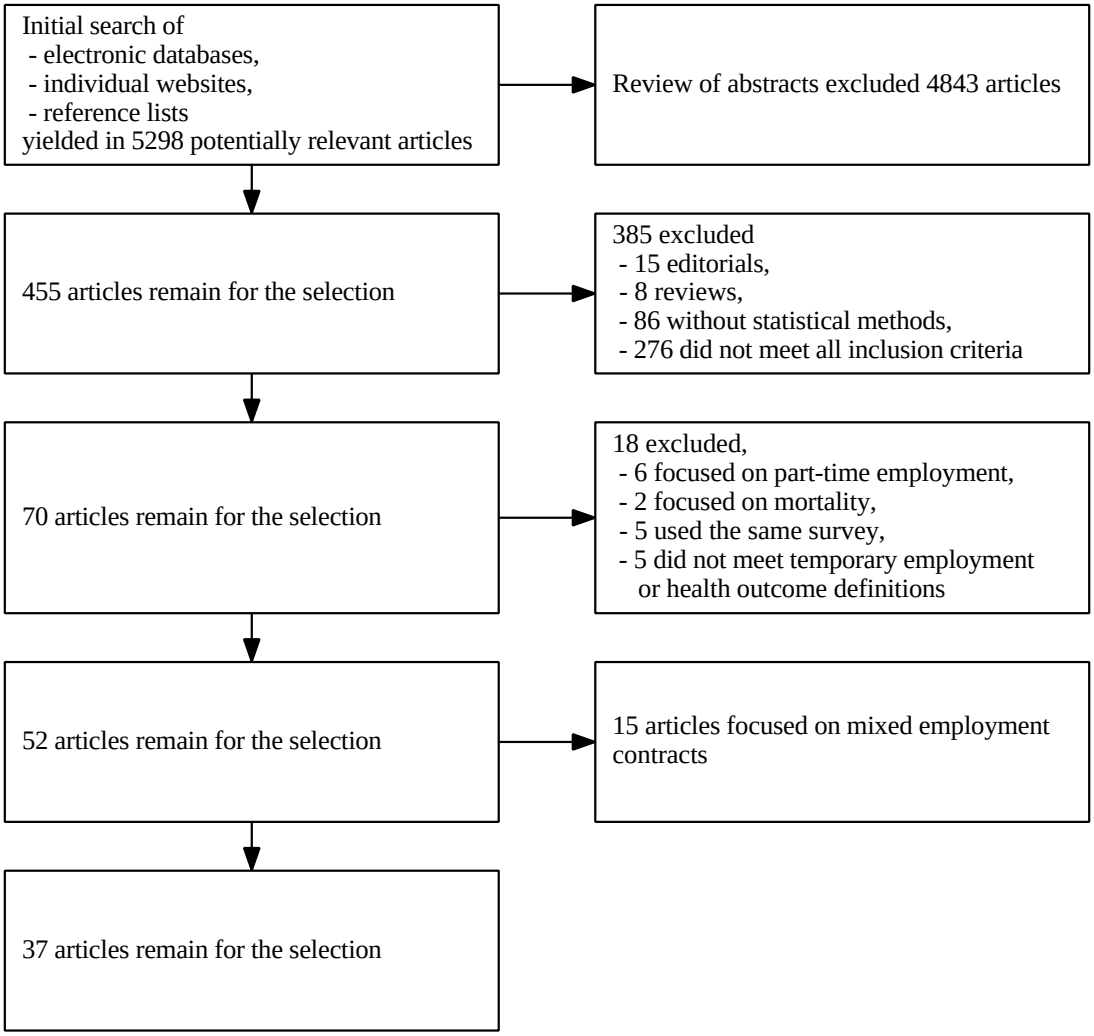

Figure 1: Selection for studies concerning with atypical employment and health

The procedure of our meta-analysis follows the main elements of the Quorum statement. The statement consists of a flow diagram and a checklist and shows the preferred structure and content of a meta-analysis (Moher et al., 1999).

2.4 Selection Process

We show details of the selection process in figure 1. Initial literature search results in 5,298 potentially relevant articles in which 455 remain for further investigation. In the second stage the number of appropriate studies is reduced to 70: Among the 455 articles 8 articles are reviews, 86 report results without presenting the statistical methods applied, 15 findings are editorials and 276 studies do not fulfill all inclusion criteria. A further reduction of the remaining articles results because 6 studies concentrate on part-time employment while 2 others use mortality as outcome variable. 5 papers do not meet our health or contract specific subgroups and 5 use the same data set. The remaining 52 articles encompass two aspects: 37 studies concentrate on specific atypical employment

Table 1: Summary statistics of health-related-behavior

	Estimates	**Point estimate**	**Range of 95 % CI**	
Health-related behavior	(N)	Mean OR	Min OR	Max OR
Alcohol dependence	2	2.50	0.87	13.1
Tobacco dependence	5	1.08	0.70	1.80
Non-participation in health check-ups	3	2.77	1.21	4.83
Total	10	1.87	0.70	13.1

contracts and 15 articles regard groups of atypical employment contracts as one indicator, the so called 'mixed contracts'.[1] Reports with 'mixed contracts' cover 48 effect sizes, 2 countries, a time period from 1984 - 2010 (year of publication: 1997 - 2013) and they are used as robustness check for our findings.

Our selection process ends with 37 studies covering 24 countries. The studies can be split up in 17 studies dealing with problems of physical health, 15 studies concentrating on mental health, 8 studies regarding occupational injuries, 5 studies focusing on sickness absence and 6 studies on health-related behavior. We obtain a combined sample size of 144 effect sizes covering the period from 1984 - 2008 (year of publication: 1997 - 2012).[2]

In table A1 in the appendix we present additional information on the studies we use in the meta-analysis. We arrange information on the location of the study, data source, study design and study year, industry sector of the study, sample size, indicator for the effect size, covariates used in the estimation, outcome measures, type of employment contract, macroeconomic surrounding and selected statistical issues.

3 Results

The subgroup of health-related behavior includes three different outcomes: alcohol intake, tobacco dependence and participation in health check-ups. However, only six of our retrieved studies[3] focus on these kinds of health outcomes while alcohol intake and participation in health check-ups represent findings of only two studies. Therefore, the number of observations is insufficient to be included into the meta-analysis and we derive the mean OR instead. We find a stronger alcohol and tobacco dependence for atypical workers. Furthermore, their participation in health check-ups is substantially lower compared to permanent employees (table 1).

[1]The included effect sizes of the additional 15 studies correspond to: Aronsson and Göransson (1999); Benavides et al. (2006); De Cuyper et al. (2010); Gimeno et al. (2004); Hammarström et al. (2011); Inoue et al. (2013); Kim et al. (2008); Nakao and Yano (2006); Rotenberg et al. (2009); Salminen et al. (2003); Scherer (2009); Tompa et al. (2010); Virtanen et al. (2001, 2004); Williamson et al. (2009).

[2]The list of 418 excluded studies is available on request.

[3]De Cuyper et al. (2008); Laaksonen et al. (2008); Nätti et al. (2009); Saha et al. (2005); Virtanen et al. (2006b, 2003b).

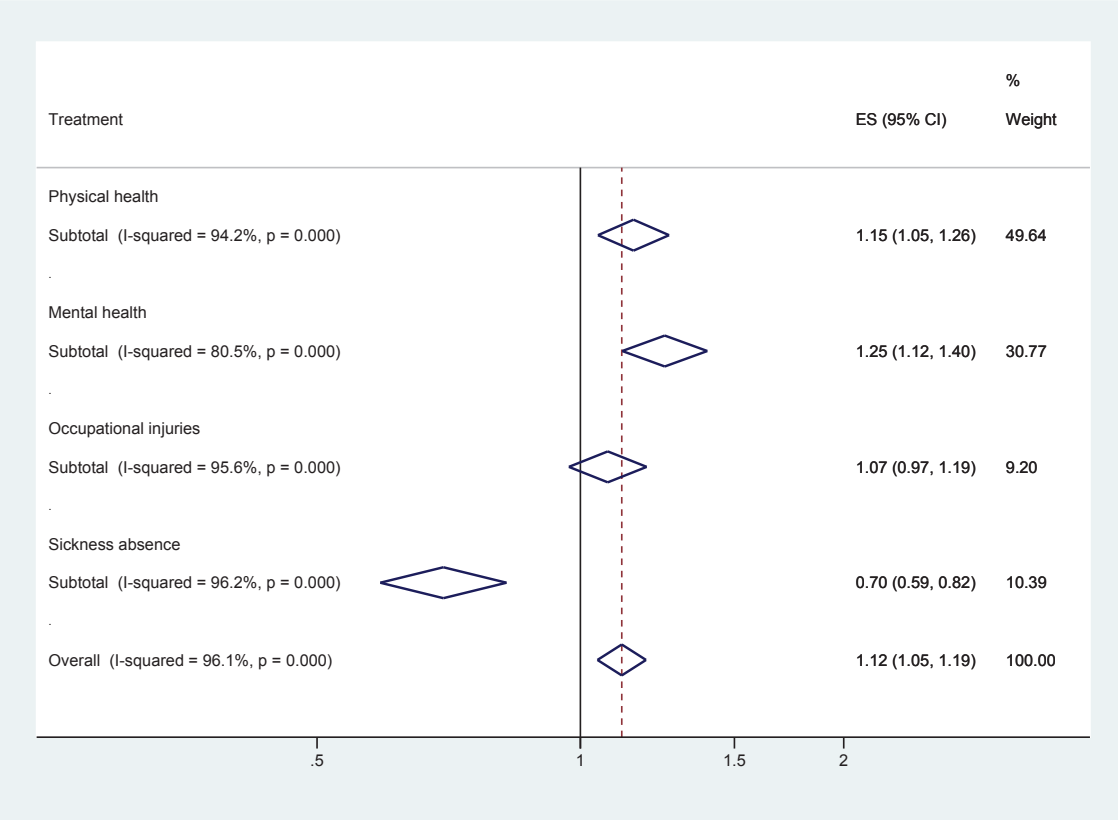

Figure 2: Mean effects separated for all health outcomes and the combined sample

Figure 2 shows the means of the effect sizes separated for the health subgroups and the mean of the overall effect. It reveals a higher probability of complaints on physical health for atypical employees compared to permanent employees. However, the Q statistic and I^2 statistic indicate a high degree of heterogeneity (Q = 1209.25, p = 0.00, I^2 = 94.2 %). The corresponding OR for mental health and for occupational injuries are also above 1 indicating an increased risk for atypical employees. The OR for sickness absences is 0.7 which means a reduced chance of absences among atypical employees. The aggregation of the four health outcomes include 144 effect sizes and the combined OR is 1.12 (95% CI 1.05 - 1.19, Q = 3704.97, p = 0.00, I^2 = 96.1%). All summary effect measures are significantly different from one at a 0.01 significance level, except the OR of occupational injuries which remains insignificant.

In figures A1 - A4 in the appendix we present the forest plots of the individual results for the four health outcomes. The strongest effect is found for sickness absence: only two out of twelve odds ratios report individual effect sizes above 1, representing a higher risk of absences. Most of the effect sizes lie significantly below an OR of 1 which yields to a OR of 0.70 (CI 0.59- 0.82, see fig. A1). The forest plot for occupational injuries is shown in figure A2. The majority of effect sizes support an increased risk of occupational injuries, although the range within the effect sizes is substantial. The forest plots of physical and mental health complaints are dominated by effect sizes of European countries. Finland

and Spain account for the biggest part of the individual effect sizes (see fig. A3 and fig. A4).

Egger's test does not show evidence of publication bias in physical health (t = -0.58, p = 0.561), sickness absence (t = 0.64, p = 0.534), occupational injuries (t = -0.41, p = 0.689) and the overall effect (t = 0.17, p = 0.863). However, as far as mental health is considered the meta-analysis shows a significant funnel plot asymmetry (t = 2.49, p = 0.016). The corresponding fail-safe N is 928 indicating that we would need additional 928 studies with zero effect to statistically nullify the overall effect. A miss of 928 undetected studies seems unlikely. Thus, we reject the hypothesis of publication bias.

The meta-regression in table 2 shows the effects of the type of contract, of country characteristics (dummy for region, unemployment rate, GDP growth rate), of the specification of health outcome and of selected characteristics of the study on the odds ratio measured in logs. Columns one and two represent model 1 and 2. The third and fourth columns include additional effect sizes from the mixed contract outcome for the two model specifications. The OR in model 1 is mainly affected by country specific characteristics and the choice of the health outcomes. If the remaining variables are held constant, employees on a casual basis show a decrease in the OR of approximately 50.44 % compared to permanent employees (see col. 1). The association between the macroeconomic indicators (GDP growth rate, unemployment rate) and morbidity is not significant. Non-European countries show a significant increase in the OR: Asia raises the OR by approximately 34.18 % and other non-European countries by 140.85 %. The ratios from Scandinavian countries[4] differ significantly from the remaining European countries and decrease the OR by approximately 17.39 %. Physical health, mental health as well as occupational injuries have a significantly positive and increasing impact on the OR. Studies using face-to-face interviews in the data gathering process increase the OR by approximately 22.51 %. In addition, the publication of significant effect sizes decreases the OR significantly. The use of count data or incidence rates as indicators reduce the OR. If the effect size is originally presented as mean the OR is significantly higher. Model 1 explains 74.65 % of I^2, the between-study variance.

Compared with model 1, model 2 shows similar impacts on the OR for employees on a casual basis, Scandinavian countries, interview type, significance of the effect size, incidence rate and mean (see col. 2). The positive impact of Asian countries[5] is still present and other non-European countries[6] increase the OR by approximately 127.96 %. As health outcomes only occupational injuries have a positive impact on the OR.

Expanding the observations by including the group of mixed contracts results in an increased impact of Scandinavian countries on the OR while the remaining countries and

[4]Scandinavian countries encompass Sweden, Finland, Norway, Denmark, Iceland and Scotland.
[5]Asian countries consist of South Korea, Taiwan and Japan.
[6]The remaining non-European countries consist of Australia, Canada, USA and Brazil.

Table 2: Results of the meta-regression

	Model 1 (1)		Model 2 (2)		Model 1* (3)		Model 2* (4)	
	Coefficient	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
Contract characteristics								
Temporary	-0.049	0.076	-0.097	0.087	0.022	0.086	-0.030	0.099
On-call	-0.056	0.206	-0.077	0.207	0.017	0.229	-0.005	0.236
Casual	-0.702***	0.223	-0.725***	0.227	-0.293	0.252	-0.362	0.272
Daily	0.173	0.165	0.127	0.170	0.215	0.202	0.162	0.214
No formal contract	0.076	0.157	0.281	0.188	0.069	0.167	0.194	0.195
Mixed contracts					0.113	0.089	0.119	0.094
Country specific characteristics								
Unemployment rate	0.016	0.014	0.011	0.015	-0.009	0.014	-0.017	0.016
GDP growth rate	0.014	0.016	0.001	0.018	0.013	0.018	0.009	0.020
Asia	0.294*	0.154	0.337**	0.169	0.151	0.139	0.125	0.148
Scandinavia	-0.191**	0.076	-0.177**	0.082	-0.213***	0.080	-0.216**	0.091
Other non-EU countries	0.879***	0.326	0.824**	0.327	-0.254	0.208	-0.203	0.282
Health outcomes								
Occupational injuries	0.520***	0.180	0.278*	0.156	0.488***	0.142	0.133	0.168
Mental health	0.285**	0.127	0.039	0.071	0.294**	0.125	0.086	0.074
Physical health	0.237**	0.120			0.215*	0.118		
Study characteristics								
No face-to-face interview	-0.255***	0.076	-0.230***	0.087	-0.256***	0.076	-0.226**	0.089
Count data	-0.192*	0.097	-0.160	0.107	-0.395***	0.095	-0.369***	0.103
Risk ratio					0.090	0.151	0.379	0.235
Incidence rate	-0.750***	0.248	-0.676***	0.249	-0.210	0.215	-0.083	0.247
Prevalence rate	0.145	0.145	0.180	0.146	-0.060	0.152	-0.016	0.158
Correlation coefficient	0.142	0.185	0.157	0.185	-0.004	0.177	-0.005	0.182
Regression coefficient	-0.057	0.165	-0.175	0.222	-0.196	0.166	-0.285	0.201
Mean	0.744***	0.152	0.761***	0.154	0.376**	0.158	0.363**	0.163
Significant effect size	-0.140**	0.060	-0.119*	0.066	-0.008	0.057	0.027	0.065
Constant	-0.048	0.273	0.239	0.224	0.254	0.268	0.529**	0.230
Observations	144		132		192		170	
I^2	0.7732		0.7367		0.8617		0.8518	
Adjusted R^2	0.7465		0.5433		0.5195		0.2099	

Notes: * Column 3 and 4 correspond to both model specifications including the effect sizes of mixed employment contracts. Reference groups: fixed-term, Europe w/o Scandinavia, sickness absence/physical health, face-to-face interviews, odds ratio, non-significant effect size. *** p<0.01, ** p<0.05, * p<0.1.

contract types don't seem to influence the OR compared to column one (see col. 3). The extension does not affect the influence of the health outcomes and interview type. However, the impacts of count data as indicator decreases while the impact of the mean decreases drastically (see col. 3). Column four differs from column 2 in the increased number of effect sizes due to the inclusion of mixed employment contracts. The impact of the contract characteristics vanishes, but the effects of Scandinavian countries and face-to-face data collection procedure remain almost constant. The use of count data or means as indicators further impacts the OR both positively and negatively. The inclusion of mixed employment contracts increases I^2 and shows a reduced fit in both models.

The inclusion of additional 48 effect sizes regarding mixed employment contracts is considered as robustness check (see the explanation on page 4). It supports our previous findings and strengthens the evidence of a higher risk of morbidity among atypical employees. The OR for physical health, mental health, occupational injuries and the combined health outcome increases to 1.17, 1.28, 1.19 and 1.13, but the effect of sickness absence declines to an OR of 0.75. All OR of the health outcomes and the combined health outcome are now significantly different from one at a 0.01 significance level. Egger's publication bias test confirms our previous findings and does not show evidence of funnel plot asymmetry except for mental health ($t = 2.66$, $p = 0.01$). However, the corresponding fail-safe N is 1,618 and contradicts any publication bias.[7] The observed effect sizes of health-related behavior increase by 4. The point estimate of alcohol and tobacco dependence decreases slightly whereby the mean OR of participation in health check-ups and the ranges of the confidence intervals remains constant. The combined point estimate of all subgroups decreases and adds up to 1.71.

4 Discussion and Limitations

The results show that atypical employment affects both mental and physical health, increases the risk of occupational injuries and decreases the risk of sickness absences. The included studies show a high heterogeneity in the meta-analysis. The performed meta-regression explains between 20.99 % and 74.65 % of the between-studies variance depending on the model and the in-/exclusion of mixed employment contracts. Overall, the heterogeneity in the effect sizes is mainly explained by differences in countries, study characteristics and the categorized health outcomes. The design of atypical employment contracts only explain a minor part of the heterogeneity. Most of the studies are cross-

[7] Physical health: N = 92, OR: 1.17 (95 % CI 1.08 - 1.27), Q = 1561.75, p = 0.00, I^2 = 94.2 %, Egger's test: t = 0.07, p = 0.948; Mental health: N = 59, OR: 1.28 (95 % CI 1.15 - 1.41), Q = 301.98, p = 0.00, I^2 = 80.8 %, Egger's test: t = 2.66, p = 0.010; Occupational injuries: N = 19, OR: 1.19 (95 % CI 1.05 - 1.34), Q = 675.7, p = 0.00, I^2 = 97.3 %, Egger's test: t = -0.14, p = 0.887; Sickness absence: N = 22, OR: 0.75 (95 % CI 0.66 - 0.84), Q = 483.06, p = 0.00, I^2 = 95.7 %, Egger's test: t = 0.72, p = 0.482; Combined health outcome: N = 192, OR: 1.13 (95 % CI 1.07 - 1.19), Q = 4623.77, p = 0.00, I^2 = 95.9 %, Egger's test: t = 0.6, p = 0.546.

sectional and do not control for gender or age differences. Changes in the OR depending on the exposure time to atypical employment contracts are not analyzed. Effects of aging and the impact of socio-economic factors (e.g. marital status, level of education, occupational status) could not be analyzed.

The positive association between a higher level of physical health complaints and employees working on an atypical employment basis may be related to worse working conditions and socioeconomic-factors. Highly irregular working hours and compressed work weeks increase the probability of physical health complaints (Martens et al., 1999). Location, size of the workplace, education and skills determine the likelihood of being employed as atypical employee. Both less educated employees and employees with suitable skills for the service industry are more likely employed atypically (Amuedo-Dorantes, 2001). Lower education yields to suboptimal self-rated health states and needs to be considered in the context of countries' specific proportion of temporary employees which may affect the individual health rating (Hammarström et al., 2011).

However, several studies consider a relation between back problems and the mental health state and indicate low mood as predictor for back pain (Failde et al., 2000; Smedley et al., 1997). A higher risk of mental health complaints of atypical employees may be related to poorer working conditions including job security, workload and wages (Inoue et al., 2010; Nakao and Yano, 2006; Yeh et al., 2007).

Atypical employees are more likely to work in more harmful industries, e.g. construction or manufacturing which increases the risk of occupational injuries (Smith et al., 2010). The increased risk of occupational injures may be related to a lower experience, lack of safety training at employees' workplace and more workplace hazards (Benavides et al., 2006; Saha et al., 2005; Villanueva and Garcia, 2011). A higher likelihood of performing manual work and provided that reemployment depends on effort atypical employees may show more effort which further increases accident probabilities. An underestimation of the findings as some previous studies mention may be present: Underreporting of occupational accidents could be due to the thread of narrowing reemployment possibilities of atypical employees after reporting an accident (Artazcoz et al., 2005; García-Serrano et al., 2010; Guadalupe, 2003; Villanueva and Garcia, 2011).

A lower sickness absence rate among atypical employees may be related to the higher risk of job loss (Bartley, 2004). Higher sickness absence rates increase the risk of job termination and unemployment among female temporary employees and a health-related selection out of work is even more likely in times where labor supply exceeds demand (Parker et al., 1997; Virtanen et al., 2006a). Changes in the employment status from insecure contracts to permanent employment increase the sickness absence rates and may be explained by a wearing off of health-related selection (Virtanen et al., 2003a).

Regarding only Asian countries increases the OR by approximately 59.2 % and most of this increase is explained by physical health complaints and the non-presence of studies

focusing on sickness absences. The inclusion of additional effect sizes confirms the result however the effect drops slightly. One explanation of this huge increase in the odds ratios is related to the higher average-weekly working time of non-permanent employees which may result in higher health risks (Kim et al., 2011). Compared to Western countries the Asian society is still more traditionally orientated were family life is higher valued than career by females (Brinton, 2001). This increased pressure from patriarchal social norms and limited reemployment possibilities in permanent employment increases the risk of health complaints (Han J, 2003; Kim et al., 2011). Japanese women are disadvantaged in finding permanent employment due to a male orientated labor market structure. This results in limited decision making possibilities and increased involuntary temporary employment (Inoue et al., 2010, 2013). Substantial reconstruction processes into non-standard employment, poorer working conditions, restricted social welfare systems and social disparities may also affect the health states of atypical employees (Han J, 2003; Kim et al., 2010; Nishikitani et al., 2012).

Compared to our general findings Scandinavian atypical employees show a lower OR of physical health complaints with an OR of 0.82. The estimates of all remaining health outcomes are substantial smaller than in our previous findings while the main reductions relate to physical health complaints and sickness absences. The inclusion of additional studies narrows this effect, however the OR is in both cases still below one. The low odds ratio may be ascribed to Sweden's labor market trend in allocating flexibility of the market with part-time employees instead of temporary employees (Bernhard-Oettel et al., 2008). The reduced job insecurity and exposure to hazards at the workplace may improve their health. Permanent employment in Finland offers a variety of health care benefits compared to atypical employees. These benefits include a wide-ranging spectrum of health care services, it offers them access to workplace physicians and it makes visits of specialists affordable. This either stimulates them to do unnecessary consultations or the increased consultation result in more reported diseases (Virtanen et al., 2006b). Permanent employees may have a higher sickness absence rate compared to atypical employees through the public sector policy. When health is impaired, the policy still guarantees permanent employees continuous employment until the final years of working life (Virtanen et al., 2006a). The lower odds ratios may also result from disproportionate interviewing of municipal employees (Virtanen et al., 2003b, 2005b, 2002, 2004). Furthermore, the most Finnish studies were undertaken in the time of economic decline or shortly after recovery and may be highly influenced by an unstable economic context (Virtanen et al., 2003b, 2005b, 2002, 2004, 2006a, 2001).

Other Non-European countries regard primarily occupational injuries and show a slight decrease in their particular OR. The extension of the included studies is mainly determined by sickness absence rates and occupational injuries. Their sickness absence rates are exceptionally small and the OR is 0.58. However this encompasses only Brazil and

Canada. The remaining European countries demonstrate remarkably high OR concerning mental health, occupational injuries and sickness absence rates. This is equivalent to an OR of 1.48 for mental health complaints and the OR for occupational injuries is 1.39.

In the following we discuss several reasons for high heterogeneity in the results of the meta-analysis in greater detail. Our approach to derive the subcategories of the health outcomes might have biased the results of the analysis. Especially the categories of physical and mental health include more disease patterns and the term 'self-rated health' incorporates a range of physical, emotional and/or personal components which may lead to overlappings between both groups (Virtanen et al., 2003b). However, the effects of the included diseases seem to comove in each particular subgroup (Benach et al., 2004; Benavides et al., 2000; Nätti et al., 2009). The definition of occupational injuries varies depending on the classification of accidents and official regularities. The categorization of fatal injuries depends either on the medical report or on the definition: 'an injury which causes the death of the victim during the year following the date of the injury' (Benavides et al., 2006; Saha et al., 2005). Some studies used the official occupational injury register which records an accident if the employees were at least one day absent from work (García-Serrano et al., 2010; Villanueva and Garcia, 2011). Accidents in the health care sector were defined as an injury contaminated with blood (Aiken et al., 1997). The exclusion of other kind of accidents and injuries not leading to accidents may veil the true effect of atypical employment on occupational injuries. Effect sizes focusing on sickness absences were more homogeneous regarding the used definitions and either used self-reported or medically certified absences depending on the duration of sickness. Most studies used a one-year-period to determine absences and distinguished between short- and long-term absences (Vahtera et al., 2004; Virtanen et al., 2006a). One study used the number of employees who missed work instead of absent days (Agudelo-Suárez et al., 2010).

Our findings may be biased by the 'healthy worker effect' (HWE). Originally described by McMichael the HWE displays a strong selection process in which relatively more healthy and active individuals are more employable within a workforce combined with generally lower mortality and morbidity rates compared to the general population (McMichael et al., 1974). This phenomenon of a healthier workforce can be decomposed into a 'healthy hire effect' (the healthiest employees are the most likely to be employed permanently), 'healthy worker survivor effect' (the less healthy employees change their workplace more frequently and have a higher risk of out-selection into temporary employment or unemployment), a 'time-since-hire effect' (decline in health status with time due to an accumulation of hazards at the work place) and a controversial discussed 'beneficial effect of work' (improved admission to health care) (Arrighi and Hertz-Picciotto, 1994; Li and Sung, 1999; Shah, 2009). A longitudinal Dutch study focused on changes in the employment contracts depending on the health status at baseline. They verified that a

lower general health status and emotional exhaustion of permanent employees predicted future unemployment and fewer musculoskeletal symptoms of temporary employees predicted permanent employment (Wagenaar et al., 2012). The latter finding is supported by Finnish fixed-term employees who reported lower sickness absences at the baseline compared to permanent employees. The difference disappeared after a change of employment contract in favor of fixed-term employees. This result is partially explained by the 'time-since-hire effect' of health-related selection process and the 'healthy hire effect' (Virtanen et al., 2003a). Next to an increased risk of job loss the HWE partially explains parts of the low sickness absence rates of atypical employees.

Another bias is known as 'time lag bias' which describes a bias of the mean risk estimate due to a temporal limit. It denotes a difference in the time until publication depending on the statistical strength of the results. Negative results of clinical trials show on average a significant time lag of two years until publication (Hopewell et al., 2007; Ioannidis, 1998). A later publication of non-significant findings can result in a decrease of the treatment effect over time and affect the mean estimates of meta-analyses (Rothstein et al., 2006). Our results show the opposite effect: non-significant effect sizes of the initial studies increase the OR significantly and support the findings of no publication bias.

Gender, age and occupational effects may have biased the findings of the meta-analysis. However, the included data do not allow for a more detailed analysis of the effects. Previous studies have shown that female employees experience a higher risk of mental distress and general health complaints due to their social role, job discrimination, financial protection, lower responsibilities at the workplace (Kim et al., 2008; Menéndez et al., 2007; O'Campo et al., 2004). The association between atypical employment and increased morbidity may be weaker for younger employees (O'Campo et al., 2004). This could be due to the consideration of temporary employment as stepping stone into permanent employment (Nätti, 1993).

Unspecified and overlapping definitions of atypical employment contracts yield to heterogeneity in the analysis and limit the attribution of varying health effects to each insecure atypical employment contract. Especially the terms 'fixed-term employment' and 'temporary employment' were used interchangeable by some studies. Only a minor fraction of the studies differentiated between 'temporary employment contracts' and 'temporary agency contracts' and the term 'temporary' incorporates a variety of atypical employment definitions (Agudelo-Suárez et al., 2010; Amuedo-Dorantes, 2001; Hammarström et al., 2011; Kompier et al., 2009; Martens et al., 1999).

Several studies focused on socio-economic factors and self-assessed health states. Age might improve the coping strategies with bad health and cause a potential bias due to the analysis of varying age groups. Gender differences in health rating show different health expectations with men being more pessimistic (Groot, 2000). Furthermore, a high socio-economic status favors pessimism whereupon optimism is related to individuals with less

income and education which can result in significant biases (Layes et al., 2012).

Our findings may present a lower bound of the increased risk of worse health. Employee's self-selection into atypical employment could have affected the OR whereby the effect sizes are too small. Surprisingly, only 12 studies discussed the major concern of selection bias and only one study used sample selection methods for the sample selection (see table A1). Furthermore, only a few of the included studies distinguished between voluntary temporary employment, preferred occupation and satisfaction. They show lower psychological symptoms among voluntary temporary employees however an unsatisfying, non-preferred temporary employment contract increases the risk of general health problems and mortality (Aronsson and Göransson, 1999; Kinnunen et al., 2011; Nätti et al., 2009).

Verification of causal effects of atypical employment contracts on varying health outcomes is limited. Our results support the hypothesis that atypical employees are exposed to a higher risk of worse health conditions and to a lower sickness absence rate from work compared to full-time, permanent employees. However, it is not explicitly distinguishable, if worse working conditions increased the health risk or if a previous minor health status of employees implemented a selection process into atypical employment. The reversed causality problems are addressed and/or discussed by roughly half of the included studies (see table A1). Due to the predominant share of cross-sectional studies only one study accounted for it explicitly. Longitudinal studies focusing on changes of employment states between baseline and follow-up allow a better understanding of the impact of atypical employment. A Finnish study of fixed-term employees showed a lower risk of psychological distress for employees moving to permanent employment and an increased risk of suboptimal health and psychological distress when moving to unstable employment (Virtanen et al., 2005b). This result is consistent with previous studies (Kompier et al., 2009; Virtanen et al., 2008).

5 Conclusion

In this paper we enlarge previous systematic knowledge on the effects of atypical employment contracts on the health status mainly represented by the Virtanen et al. meta-analysis (2005a) in several directions. We broaden the range of countries by especially including studies from non-European countries. We account for the evidence of more recent publications and consider additional forms of atypical employment and further dimensions of health. The inclusion of studies from the time period 2002 - 2010 reveals an increased risk of physical health complaints compared to previous knowledge. Our OR of mental health complaints confirms the finding of the previous analysis. Regarding sickness absences we find a much stronger risk of going to work while being ill. We also corroborate the Virtanen findings that atypical employment increases the risk of occupa-

tional injuries. In addition, we reveal that atypical employment changes health behavior. We find a higher risk of alcohol intake, tobacco dependence and state lower participation rates in health check-ups. We only find limited evidence that the type of atypical contract is important for the negative health effect. The same is true for the role of the macroeconomic background of the studies. We do not find a significant relationship between morbidity and unemployment rates or growth rates. On the other hand, the country effects seem to be very important. The same is true for selective methodological issues of the data gathering process.

A homogeneous definition of health outcomes and different atypical employment contracts is desirable to improve the comparisons between the countries. We strongly recommend to improve the evidence of any existing selection bias and concerns of reverse causality. In cross-sectional studies the distinction between voluntary and involuntary employment represents an acceptable approach. Overall, we state a necessity for more sophisticated research designs which explicitly consider different control groups, different working biographies and different stages in this biography. In this respect, the research could benefit from the approaches used in studies on the relationship between unemployment and health. To some extent our study also shows the limitations of the concept of meta-analysis in applications with heterogeneous outcome indicators.

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Appendix

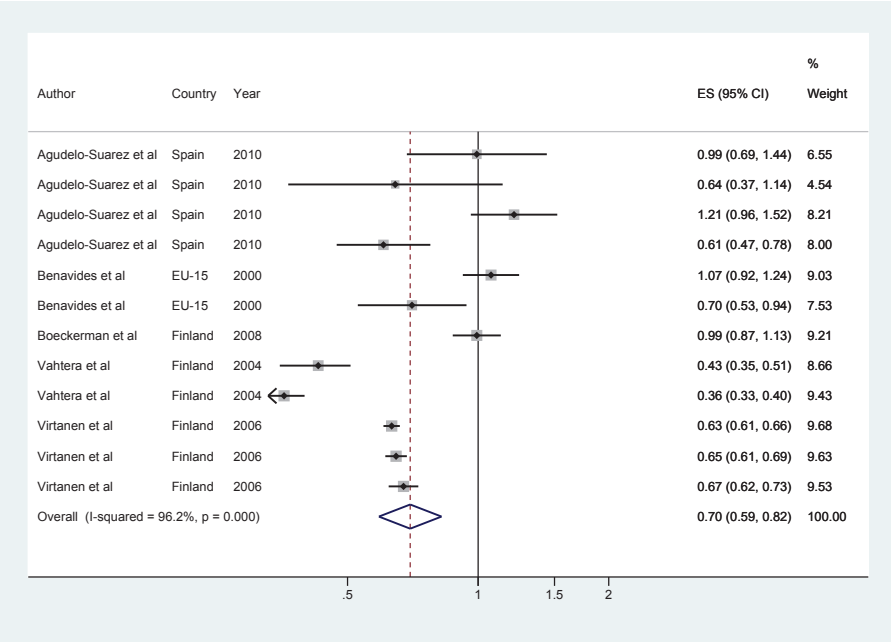

Fig. A2: Forrest plot of sickness absence

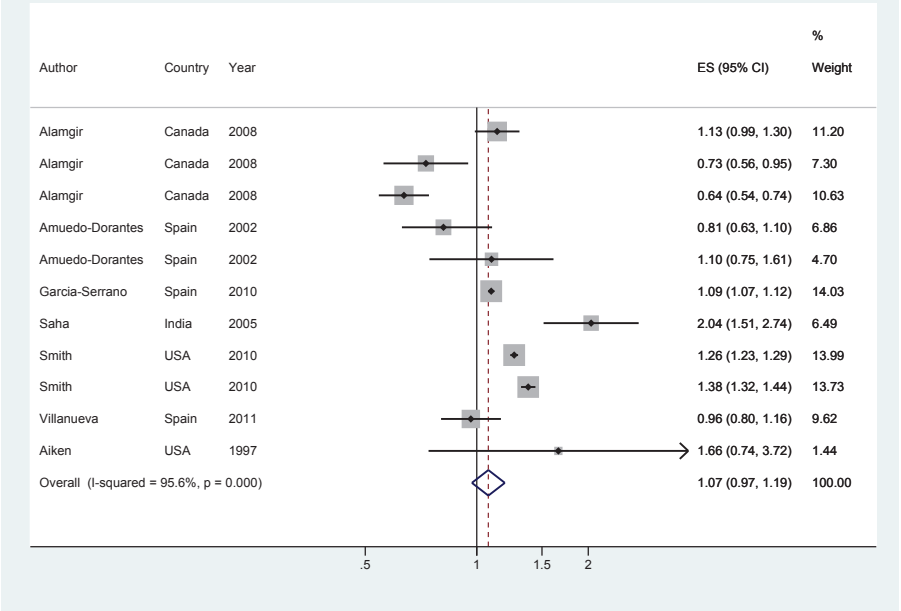

Fig. A1: Forrest plot of occupational injuries

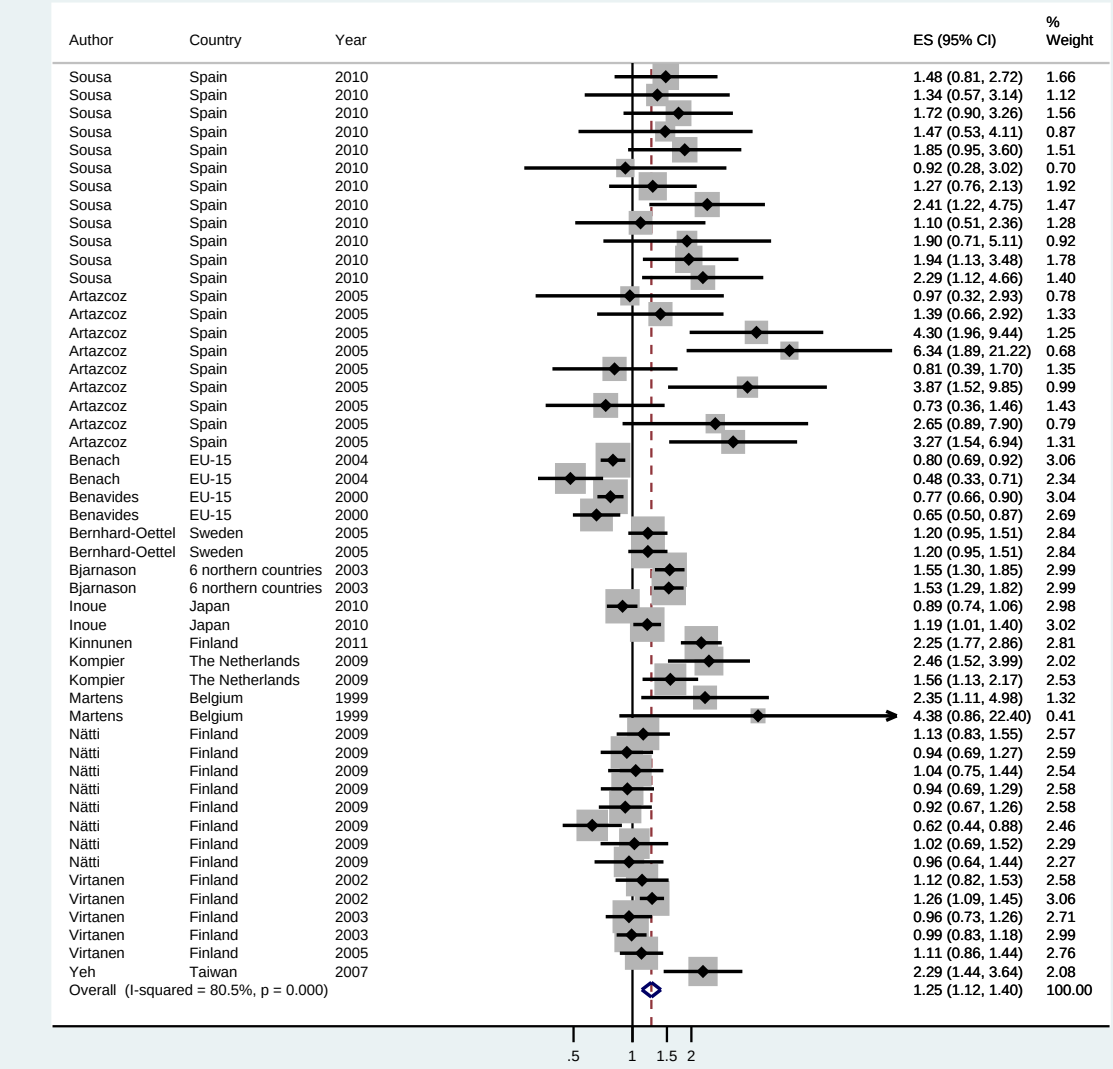

Fig. A3: Forrest plot of mental health

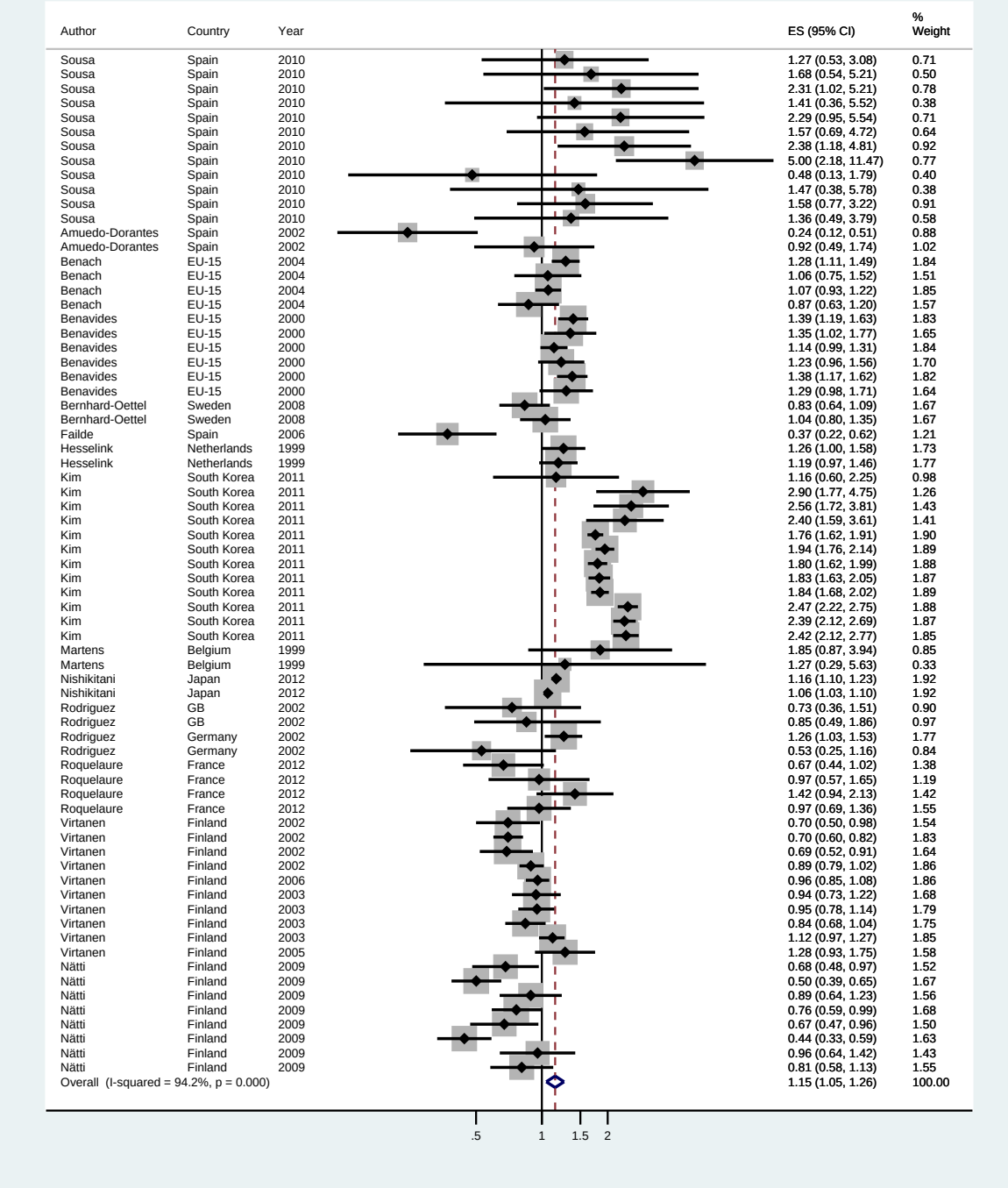

Fig. A4: Forrest plot of physical health

Table A1: Overview of included studies according to a distinct classification of atypical employment arrangements

Author (Year)	**Location**	**Data Source**	**Study Design/ Study Year**	**Industry Sector**[1]	**Sample Size**[2]	**Indicator for the Effect Size**[3]	**Adjusted Variables**[4]	**Outcome Measure**	**Type of Contract**	**Macro Economic Surrounding**	**Reverse Causality**[5]	**Selection Bias**[6]	**Study Focus**[7]
Agudelo-Suárez et al. (2010)	Spain, (Barcelona, Huelva, Madrid, Valencia)	ITSAL project	cross-sectional (2009)	1	2,059	adj. OR	age, education, gender, income, self-perceived health/mental health, type of contract	sickness presence	temporary, no formal contract	-	1	0	yes
Aiken et al. (1997)	USA	Study of hospital Aids care	prospective (1990-1991)	2	920	IRR	-	occupational injuries	temporary	-	0	0	no
Alamgir et al. (2008)	Canada (BC)	Workplace Health Indicator Tracking and Evaluation Database	cross-sectional (2004-2005)	2	145	adj. RR	age, experience, gender, health region, subsector, type of contract	occupational injuries	casual	-	0	0	no
Alamgir et al. (2008)	Canada (BC)	Workplace Health Indicator Tracking and Evaluation Database	cross-sectional (2005-2006)	2	8,640	adj. RR	age, experience, gender, health region, subsector, type of contract	occupational injuries	casual	-	0	0	yes
Amuedo-Dorantes (2002)	Spain	ENCT	retrospective (1997)	1	3,804	regression coefficient	age, education, gender, hours of work, type of contract, working conditions	occupational injuries, physical health	fixed-term, project	-	0	0	yes
Artazcoz et al. (2005)	Spain (Catalonia)	Catalonian health survey	cross-sectional (2002)	1	2,472	adj. OR	age	mental health	fixed-term, temporary, no formal contract	-	1	1	yes
Benach et al. (2004)	15 countries of EU	Second and Third European Survey on Working Conditions	cross-sectional (1995, 2000)	1	15,146; 21,703	OR, adj. OR	age, gender, type of contract	mental & physical health	fixed-term, temporary	unemployment, social protection, GNP	1	0	yes
Benavides et al. (2000)	15 countries of EU	Second European Survey on Working Conditions	cross-sectional (1996)	1	15,146	OR, adj. OR	age, gender, type of contract	mental & physical health, sickness absence	fixed-term, temporary	unemployment, social protection, GNP	1	0	yes

Table A1: Overview of included studies according to a distinct classification of atypical employment arrangements

Author (Year)	**Location**	**Data Source**	**Study Design/ Study Year**	**Industry Sector**[1]	**Sample Size**[2]	**Indicator for the Effect Size**[3]	**Adjusted Variables**[4]	**Outcome Measure**	**Type of Contract**	**Macro Economic Surrounding**	**Reverse Causality**[5]	**Selection Bias**[6]	**Study Focus**[7]
Bernhard-Oettel et al. (2005)	Sweden	Survey	cross-sectional (1998)	2	954	regression coefficient	individual characteristics, job control, job insecurity, type of contract	mental health	fixed-term, on-call	-	1	0	yes
Bernhard-Oettel et al. (2008)	Sweden	Survey	cross-sectional (2004)	2	716	regression coefficient	background, employment preference, type of contract	physical health	fixed-term, on-call	-	1	0	yes
Bjarnason et al. (2003)	Denmark, Finland, Iceland, Norway, Scotland, Sweden	Youth Unemployment and Marginalization Project	cross-sectional (1996-1997)	1	7,307	regression coefficient	economic situation, living arrangements, SES, support from parents, unemployment	mental health	temporary	-	0	0	no
Böckerman et al. (2008)	Finland	Quality of Work Life Survey	cross-sectional (1997)	2	2,815	regression coefficient	adverse working conditions, age, company characteristics, education, gender, type of contract, work shifts	sickness absence	temporary	regional unemployment, industry indicators	0	0	no
Failde et al. (2000)	Spain	Survey	cross-sectional (1996)	2	890	OR, adj. OR	age, gender, lifestyle, occupational category, type of contract,	physical health	temporary	-	0	0	no
García-Serrano et al. (2010)	Spain	EAT	cross-sectional (2004-2007)	2	3,575,146	regression coefficient	characteristics of accident, job attributes, personal & establishment characteristics, type of contract	occupational injuries	fixed-term	-	0	2	yes
Hesselink et al. (1999)	The Netherlands	Dutch Labour Force Survey	cross-sectional (1996)	1	1,022	mean	-	physical health	temporary	-	0	0	no
Inoue et al. (2010)	Japan	Comprehensive Survey of Living Conditions	cross-sectional (2007)	1	17,178	adj. OR	age, income, marital status, occupational class characteristics	mental health	temporary	-	1	1	yes
Kim et al. (2011)	South Korea	Social Statistics Survey	cross-sectional (1995,1999, 2003,2006)	1	89,348	adj. PR	age	physical health	temporary, daily	-	1	1	yes
Kinnunen et al. (2011)	Finland	Survey	cross-sectional (2008)	2	1,014	regression coefficient	age, contract preferences, education, gender, type of contract	mental health	temporary	-	1	1	yes

Table A1: Overview of included studies according to a distinct classification of atypical employment arrangements

Author (Year)	**Location**	**Data Source**	**Study Design/ Study Year**	**Industry Sector**[1]	**Sample Size**[2]	**Indicator for the Effect Size**[3]	**Adjusted Variables**[4]	**Outcome Measure**	**Type of Contract**	**Macro Economic Surrounding**	**Reverse Causality**[5]	**Selection Bias**[6]	**Study Focus**[7]
Kompier et al. (2009)	The Netherlands	Intomart / GfK	cross-sectional & prospective (2004-2006)	1	2,454; 1,865	mean	-	mental health	temporary, on-call	-	1	1	yes
Martens et al. (1999)	Belgium	Survey	cross-sectional (1994)	2	480	mean, regression coefficient	age, job autonomy, leisure time & social activities, raising children, smoking behavior, type of contract, workload	mental & physical health	temporary, on-call	-	0	1	yes
Nätti et al. (2009)	Finland	Quality of Worklife Survey	prospective (1984-2000)	1	4,502; 3,345	hazard ratio	background, health-related and work-related factors	mental & physical health	temporary	-	0	1	no
Nishikitani et al. (2012)	Japan	Comprehensive Survey of Living Conditions	cross-sectional (2001, 2004, 2007)	1	641,102	regression coefficient	age, children, cohort, income, marital status, period, type of contract	physical health	fixed-term	-	0	0	yes
Rodriguez (2002)	Britain, Germany	SOEP, BHPS	prospective (1991-1993)	1	18,092	adj. OR	age, education, gender, health status, home ownership, household members, income, marital status, unemployment, unpaid housekeeping work	physical health	fixed-term, no formal contract	-	2	0	yes
Roquelaure et al. (2012)	France (Pays de la Loire)	Surveillance System for Musculoskeletal Disorders Data	cross-sectional (2002-2005)	1	1,493	adj. OR	age, gender	physical health	temporary	-	0	0	yes
Saha et al. (2005)	India	Survey	retrospective (1996-2000)	2	726	Mean, RR	age, education, experience, nature of work, tobacco usage	occupational injuries	temporary	-	0	0	yes
Smith et al. (2010)	USA (WA)	State Fund workers' compensation claim	cross-sectional (2003-2006)	2	342,540 (claims)	incidence rate	-	occupational injuries	temporary	-	0	0	yes

Table A1: Overview of included studies according to a distinct classification of atypical employment arrangements

Author (Year)	**Location**	**Data Source**	**Study Design/ Study Year**	**Industry Sector**[1]	**Sample Size**[2]	**Indicator for the Effect Size**[3]	**Adjusted Variables**[4]	**Outcome Measure**	**Type of Contract**	**Macro Economic Surrounding**	**Reverse Causality**[5]	**Selection Bias**[6]	**Study Focus**[7]
Sousa et al. (2010)	Spain	ITSAL project	cross-sectional (2008-2009)	1	2,358	adj. OR	age, education, income, sector of economic activity	mental & physical health	temporary, no formal contract	-	1	0	yes
Vahtera et al. (2004)	Finland	Survey	prospective (1990)	2	41,736	hazard ratio	age, occupational status, type of contract	sickness absence	temporary	-	0	1	no
Villanueva et al. (2011)	Spain	Spanish social Security Administration	cross-sectional (2001)	2	4,032	adj. OR	age, gender, job attributes, type of employment contract	occupational injuries	temporary	-	0	0	yes
Virtanen et al. (2002)	Finland	Eight town study	cross-sectional (1997-1998)	2	8,557	OR, adj. OR	age, income, marital status, occupational status, type of contract	mental & physical health	fixed-term	-	1	1	yes
Virtanen et al. (2003)	Finland	Health and Social Support Project	prospective (1998)	1	15,468	adj. OR	age, demographics, health risk behaviors, psychosocial factors	mental & physical health	fixed-term	-	1	1	yes
Virtanen et al. (2005)	Finland	Temporary Employees in Municipal Jobs Study	prospective (1998-2002)	2	1,246	adj. OR	age, health status, marital status, occupational status	mental & physical health	fixed-term	-	1	1	yes
Virtanen et al. (2006)	Finland	Finnish Public Sector Study	prospective (1996)	2	60,623	adj. OR	age, employer, gender, income, occupational status, type of contract, urbanization level	sickness absence	temporary	-	0	1	yes
Virtanen et al. (2006)	Finland	Health and Social Support Project	prospective (2003)	1	12,627	adj. OR	age, depression, education, gender, health status	physical health	fixed-term	-	1	0	yes
Ying-Jung et al. (2007)	Taiwan	Survey	cross-sectional (2004)	2	249	regression coefficient	job stress, organizational & occupational commitment, psychological contract	mental health	temporary	-	0	0	yes

Notes: 1) An unspecified industry sector is classified as 1. If a specific sector is analyzed it is classified as 2. 2) Sample size as presented in the study report. 3) Abbreviations: OR (odds ratio), IRR (incidence rate ratio), RR (relative risk) and PR (prevalence ratio). 4) Variables which were used for adjustment in the study report. 5) & 6) Zero refers to 'not mentioned at all', 1 refers to 'addressed or discussed' and 2 refers to 'explicitly controlled for'. 7) Reports if the focus of the study report is directly related to atypical employment contracts and health outcomes.

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Atypical employment and health: A meta-analysis

Abstract
In this meta-analysis we provide new quantitative evidence on the relationship between the characteristics of working contracts and worker's health. We examine 52 studies covering 26 countries in the time period 1984 - 2010 with a combined sample size of 192. We apply a random effects model using odds ratios and their 95% confidence intervals as measures for the effect size. We distinguish between six types of employment contracts with decreasing security levels (fixed-term, temporary, casual, on-call, daily, no formal contract) and classify the health outcomes into five subgroups (sickness absence, occupational injuries, health-related behavior, mental health and physical health). Furthermore, we control for selected dimensions of the socioeconomic environment of the studies, e.g. the unemployment rate and GDP growth rate. Summary findings show a higher risk of occupational injuries for atypical employees compared to the reference group. Atypical employment increases complaints about mental and physical health and has a negative impact on health-related behavior. Sickness absence works in the opposite direction and permanent employees are more likely to be absent from work. The heterogeneity of the effect sizes between different contracts of atypical employment is low. Effect sizes are country specific and depend on the health outcome indicators. The macroeconomic surrounding - unemployment rate and GDP growth rate - don't cause variation in study results. The 'healthy worker effect' may lead to an overestimation of the impact of workers' atypical employment contract on the health status. More research work which explicitly focuses on the problems of endogeneity, reverse causality and the selection bias is necessary. Furthermore, additional control groups and the employment biography of workers have to be taken into account.

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