Correlation between Data : Electric Vehicle Accident , Israel 2018-19

Importing the libraries

In [1]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import networkx as nx
import matplotlib.colors as colors
import  matplotlib.cm as cm
import plotly.express as px

import plotly
import plotly.offline as plty
plt.rc('axes', labelsize=14)

from shapely.geometry import Point
%matplotlib inline

import warnings
warnings.filterwarnings("ignore")
```

In [2]:
```python
df_main = pd.read_csv('/Users/divyabisht/Desktop/electricvehicleaccidentbs.csv')
df_main = pd.concat([df_main, pd.to_datetime(df_main['accident_timestamp']).map(lambda x: x.year).rename
                pd.to_datetime(df_main['accident_timestamp']).map(lambda x: x.month).rename('Month'),
                pd.to_datetime(df_main['accident_timestamp']).map(lambda x: 1).rename('Day')], axis=1)
df_main
```

Out[2]:

	accident_id	provider_and_id	provider_code	file_type_police	involved_type	involved_type_hebrew	license_acquiring_date	age_group	ag
0	2018013760	32018013760	3	3	3	נפגע	0	18	
1	2018013760	32018013760	3	3	1	נהג	0	99	
2	2018042928	32018042928	3	3	1	נהג	2011	7	
3	2018042928	32018042928	3	3	2	נהג נפגע	0	7	
4	2018078809	32018078809	3	3	2	נהג נפגע	2000	8	
...	...	...	...	...	...	...	...	...	
7902	2018005642	12018005642	1	1	2	נהג נפגע	2010	7	
7903	2018056690	12018056690	1	1	1	נהג	2003	7	
7904	2018056690	12018056690	1	1	2	נהג נפגע	0	8	
7905	2018084262	12018084262	1	1	1	נהג	1972	15	
7906	2018084262	12018084262	1	1	2	נהג נפגע	0	4	

7907 rows × 121 columns

In [43]:
```python
df_main.describe()
```

Out[43]:

	accident_id	provider_and_id	provider_code	file_type_police	involved_type	license_acquiring_date	age_group	sex	involve
count	7.907000e+03	7.907000e+03	7907.000000	7907.000000	7907.000000	7907.000000	7907.000000	7083.000000	
mean	2.018520e+09	2.687371e+10	2.485519	2.512837	1.606804	1010.266220	26.900468	1.112099	
std	5.002365e+05	8.742830e+09	0.874281	0.858540	0.626443	999.072692	36.710342	0.567524	
min	2.018000e+09	1.201800e+10	1.000000	1.000000	1.000000	0.000000	1.000000	0.000000	
25%	2.018048e+09	1.201909e+10	1.000000	3.000000	1.000000	0.000000	6.000000	1.000000	
50%	2.018094e+09	3.201806e+10	3.000000	3.000000	2.000000	1963.000000	9.000000	1.000000	
75%	2.019046e+09	3.201903e+10	3.000000	3.000000	2.000000	2000.000000	15.000000	1.000000	
max	2.019100e+09	3.201910e+10	3.000000	3.000000	3.000000	2019.000000	99.000000	2.000000	

8 rows × 69 columns

In [3]:
```
Title = " "
def PlotPiechart(labels, values, columnName):
    fig = {
      "data": [
        {
          "labels": labels,
          "values": values['provider_and_id'],
          #"domain": {"x": [0, 1]},
          "name": columnName,
          "hoverinfo":"label+percent+name",
          "hole": .6,
          "type": "pie"
        },
         ],
      "layout": {
           # "title":"Percentage of Accident happened in situations : " + columnName,
            "title":Title,
            "annotations": [
                {
                    "font": {
                        "size": 40
                    },
                    "showarrow": False,
                    "text": " ",
                    "x": 5.50,
                    "y": 0.5
                }
            ]
        }
    }
    plty.iplot(fig)
```

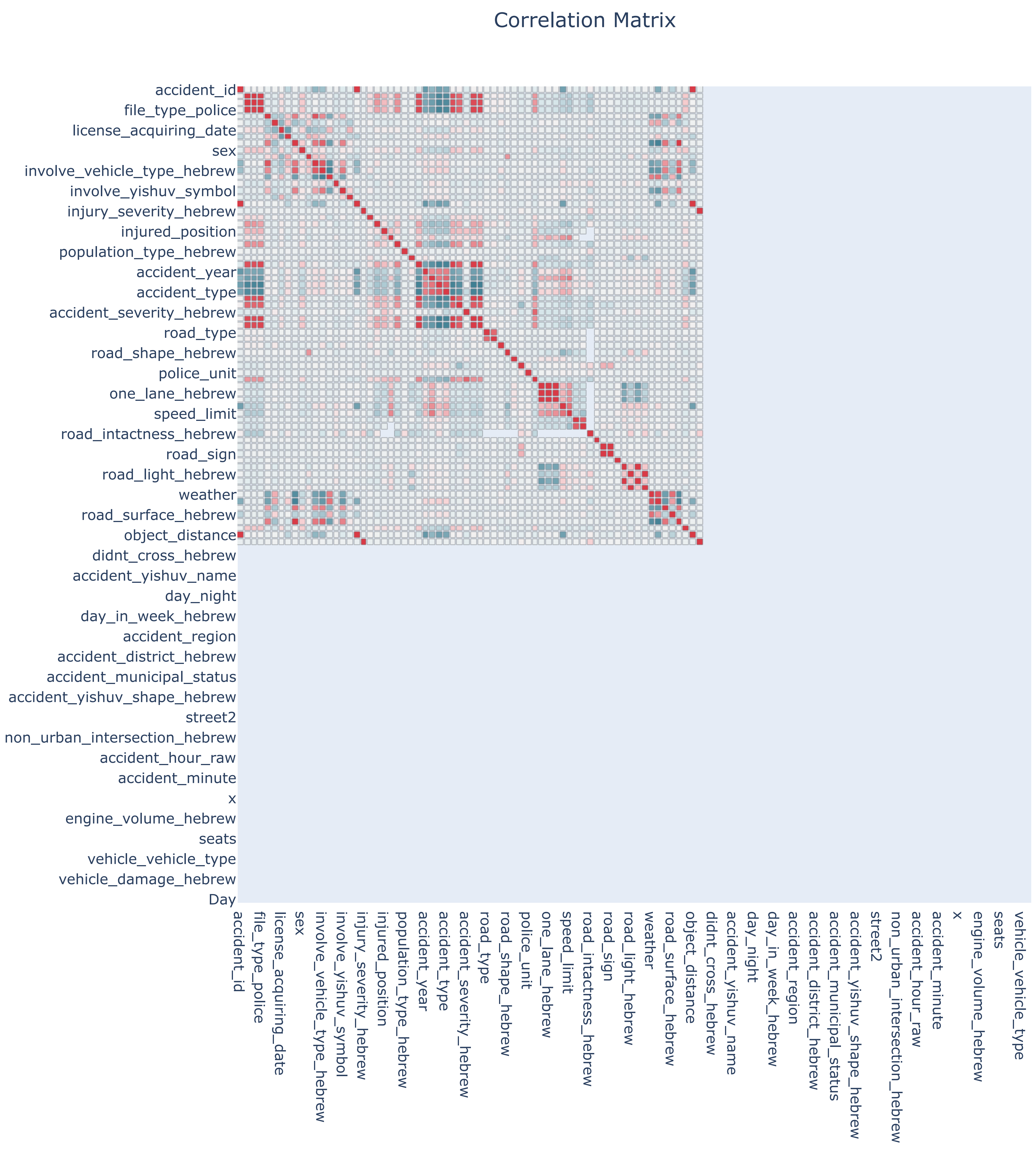
Correlation Matrix

A correlation matrix is a table showing correlation coefficients between variables. Each cell in the table shows the correlation between two variables. A correlation matrix is used to summarize data, as an input into a more advanced analysis, and as a diagnostic for advanced analyses.

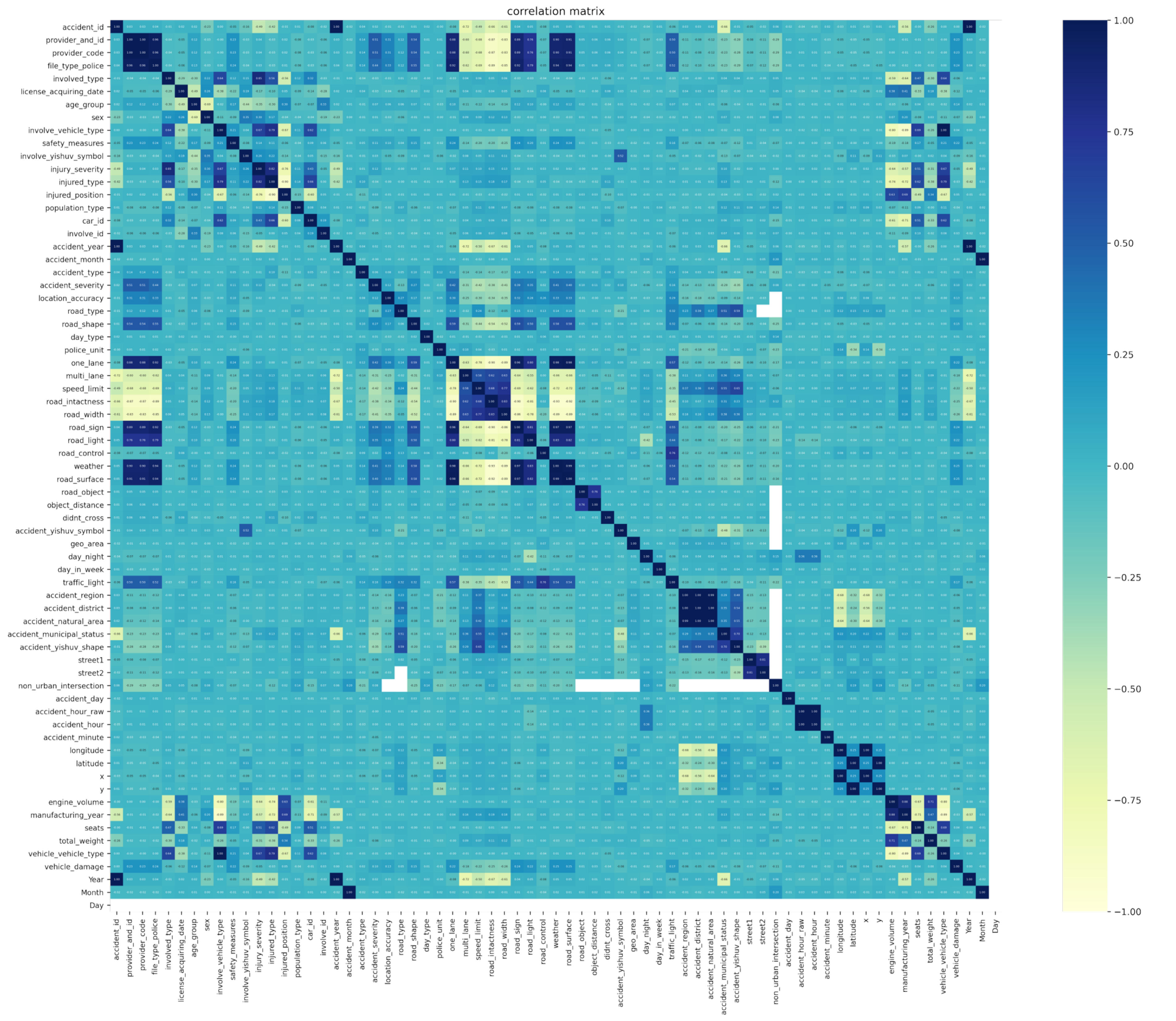
The measure is best used in variables that demonstrate a linear relationship between each other.

Better Reference : https://towardsdatascience.com/better-heatmaps-and-correlation-matrix-plots-in-python-41445d0f2bec (https://towardsdatascience.com/better-heatmaps-and-correlation-matrix-plots-in-python-41445d0f2bec)

In [4]:
```
import plotly.graph_objects as go
import plotly.io as pio

corr = df_main.corr()

X = list(df_main.columns)
sns_colorscale = [[0.0, '#3f7f93'], #cmap = sns.diverging_palette(220, 10, as_cmap = True)
 [0.071, '#5890a1'],
 [0.143, '#72a1b0'],
 [0.214, '#8cb3bf'],
 [0.286, '#a7c5cf'],
 [0.357, '#c0d6dd'],
 [0.429, '#dae8ec'],
 [0.5, '#f2f2f2'],
 [0.571, '#f7d7d9'],
 [0.643, '#f2bcc0'],
 [0.714, '#eda3a9'],
 [0.786, '#e8888f'],
 [0.857, '#e36e76'],
 [0.929, '#de535e'],
 [1.0, '#d93a46']]

heat = go.Heatmap(z=corr,
                  x=X,
                  y=X,
                  xgap=1, ygap=1,
                  colorscale=sns_colorscale,
                  colorbar_thickness=20,
                  colorbar_ticklen=3
                   )

title = 'Correlation Matrix'

layout = go.Layout(title_text=title, title_x=0.5,
                   width=1000, height=1000,
                   xaxis_showgrid=False,
                   yaxis_showgrid=False,
                  yaxis_autorange='reversed')

fig=go.Figure(data=[heat], layout=layout)
fig.show()
```



```
In [6]: fig, ax = plt.subplots(figsize=(24, 18), dpi=300)
        corr = df_main.corr()

        hm = sns.heatmap(corr, cbar=True, vmin=-1, vmax=1,
                         fmt='.2f', annot_kws={'size': 3}, annot=True,
                         square=True, cmap="YlGnBu")

        ticks = np.arange(corr.shape[0]) + 0.5
        ax.set_xticks(ticks)
        ax.set_xticklabels(corr.columns, rotation=90, fontsize=8)
        ax.set_yticks(ticks)
        ax.set_yticklabels(corr.index, rotation=360, fontsize=8)

        ax.set_title('correlation matrix')
        #plt.tight_layout()
        #plt.savefig("corr_matrix_incl_anno_double.png", dpi=300)
        fig.show()
```



In [7]:
```
df_main.corr()
```

Out[7]:

	accident_id	provider_and_id	provider_code	file_type_police	involved_type	license_acquiring_date	age_group	sex
accident_id	1.000000	0.034533	0.034476	0.038039	-0.007556	0.021389	0.022191	-0.233318
provider_and_id	0.034533	1.000000	1.000000	0.964264	-0.043308	-0.053462	0.123681	-0.028205
provider_code	0.034476	1.000000	1.000000	0.964264	-0.043307	-0.053464	0.123680	-0.028192
file_type_police	0.038039	0.964264	0.964264	1.000000	-0.038708	-0.056568	0.125231	-0.032791
involved_type	-0.007556	-0.043308	-0.043307	-0.038708	1.000000	-0.290247	-0.302609	0.219450
...	...	...	...	...	...	...	...	...
vehicle_vehicle_type	0.001562	-0.001242	-0.001242	0.004134	0.635835	-0.382185	-0.016676	-0.105805
vehicle_damage	0.001683	0.231977	0.231977	0.239332	-0.060905	-0.116467	0.144095	-0.074786
Year	0.998339	0.034636	0.034579	0.038317	-0.008203	0.020861	0.023221	-0.233867
Month	-0.016031	-0.019099	-0.019098	-0.015673	0.001822	0.015690	0.009279	0.004781
Day	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

69 rows × 69 columns

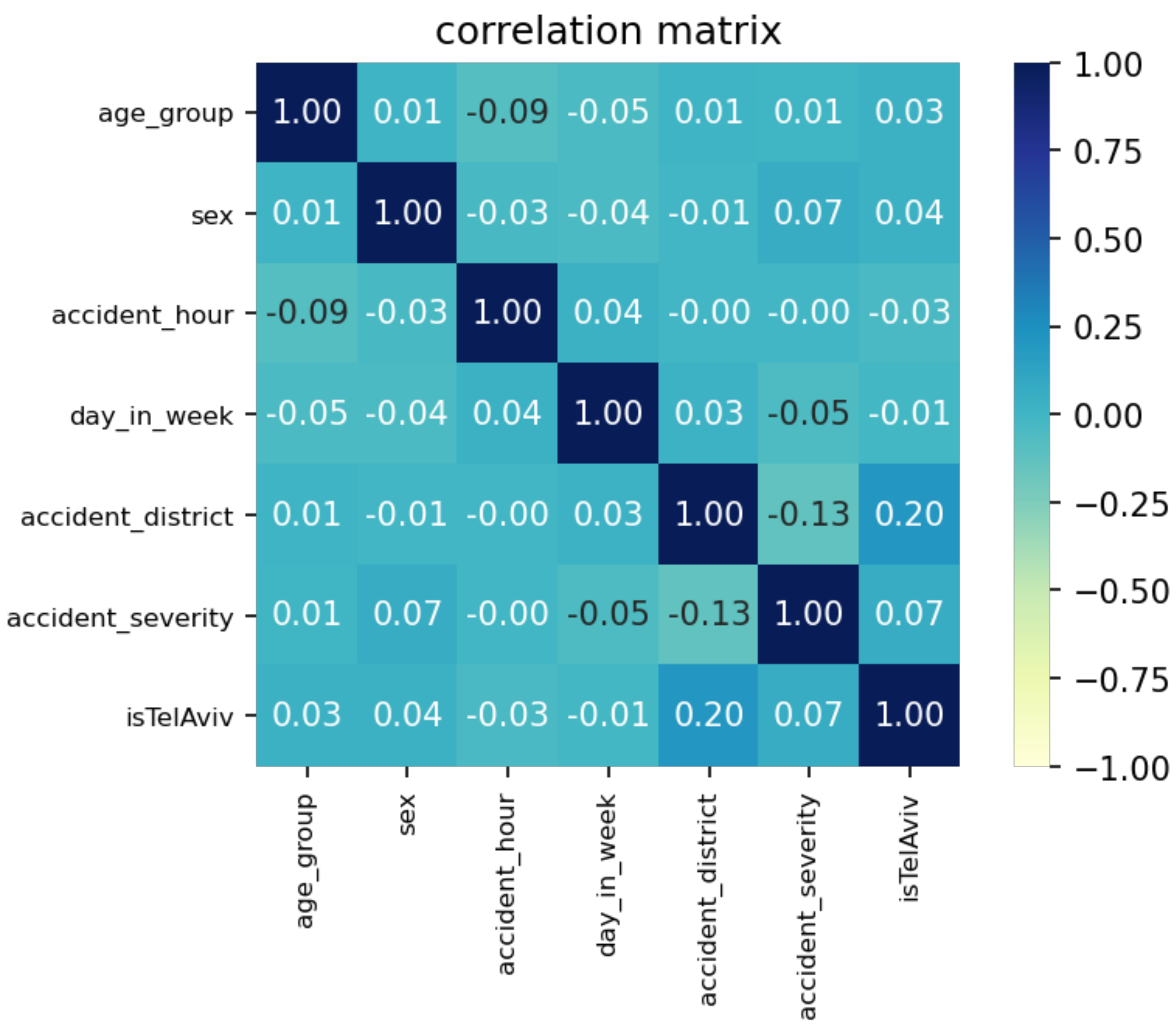
In [5]:
```
f = df_main[['age_group', 'sex', 'accident_hour', 'day_in_week', 'accident_district', 'accident_severity
f['isTelAviv'] = (df_main['accident_region'] == 5)
f = df[df['age_group']!=99]

f = df.dropna().reset_index(drop=True)

ig, ax = plt.subplots(figsize=(6, 4), dpi=150)
orr = df.corr()

m = sns.heatmap(corr, cbar=True, vmin=-1, vmax=1,
                fmt='.2f', annot_kws={'size': 10}, annot=True,
                square=True, cmap="YlGnBu")

icks = np.arange(corr.shape[0]) + 0.5
x.set_xticks(ticks)
x.set_xticklabels(corr.columns, rotation=90, fontsize=8)
x.set_yticks(ticks)
x.set_yticklabels(corr.index, rotation=360, fontsize=8)

x.set_title('correlation matrix')
plt.tight_layout()
plt.savefig("corr_matrix_incl_anno_double.png", dpi=300)
ig.show()

rint(df)

f.corr()
```

```
      age_group  sex  accident_hour  day_in_week  accident_district  \
0            18  1.0             14            2                 51   
1             7  2.0              8            4                 31   
2             7  1.0              8            4                 31   
3             8  1.0             14            6                 24   
4            13  1.0             16            1                 24   
...         ...  ...            ...          ...                ...   
6285          7  1.0             13            2                 51   
6286          7  1.0             13            3                 31   
6287          8  2.0             13            3                 31   
6288         15  1.0             19            7                 99   
6289          4  1.0             19            7                 99   

      accident_severity  isTelAviv  
0                     3       True  
1                     3      False  
2                     3      False  
3                     3      False  
4                     3      False  
...                 ...        ...  
6285                  3       True  
6286                  3      False  
6287                  3      False  
6288                  3      False  
6289                  3      False  

[6290 rows x 7 columns]
```

Out[5]:

	age_group	sex	accident_hour	day_in_week	accident_district	accident_severity	isTelAviv

age_group	1.000000	0.014583	-0.085804	-0.046339	0.014548	0.007344	0.032385
sex	0.014583	1.000000	-0.027839	-0.041498	-0.006115	0.069606	0.036195
accident_hour	-0.085804	-0.027839	1.000000	0.036931	-0.002482	-0.002357	-0.034494
day_in_week	-0.046339	-0.041498	0.036931	1.000000	0.025378	-0.049039	-0.008396
accident_district	0.014548	-0.006115	-0.002482	0.025378	1.000000	-0.127950	0.204999
accident_severity	0.007344	0.069606	-0.002357	-0.049039	-0.127950	1.000000	0.066490
isTelAviv	0.032385	0.036195	-0.034494	-0.008396	0.204999	0.066490	1.000000



Low Correleations

In [6]:
```
from scipy.stats import pearsonr
import pandas as pd

def calculate_pvalues(df):
    df = df.dropna()._get_numeric_data()
    dfcols = pd.DataFrame(columns=df.columns)
    pvalues = dfcols.transpose().join(dfcols, how='outer')
    for r in df.columns:
        for c in df.columns:
            pvalues[r][c] = round(pearsonr(df[r], df[c])[1], 4)
    return pvalues

calculate_pvalues(df)
```

Out[6]:

	age_group	sex	accident_hour	day_in_week	accident_district	accident_severity	isTelAviv
age_group	0.0	0.2475	0.0	0.0002	0.2486	0.5604	0.0102
sex	0.2475	0.0	0.0272	0.001	0.6278	0.0	0.0041
accident_hour	0.0	0.0272	0.0	0.0034	0.844	0.8517	0.0062
day_in_week	0.0002	0.001	0.0034	0.0	0.0442	0.0001	0.5056
accident_district	0.2486	0.6278	0.844	0.0442	0.0	0.0	0.0
accident_severity	0.5604	0.0	0.8517	0.0001	0.0	0.0	0.0
isTelAviv	0.0102	0.0041	0.0062	0.5056	0.0	0.0	0.0

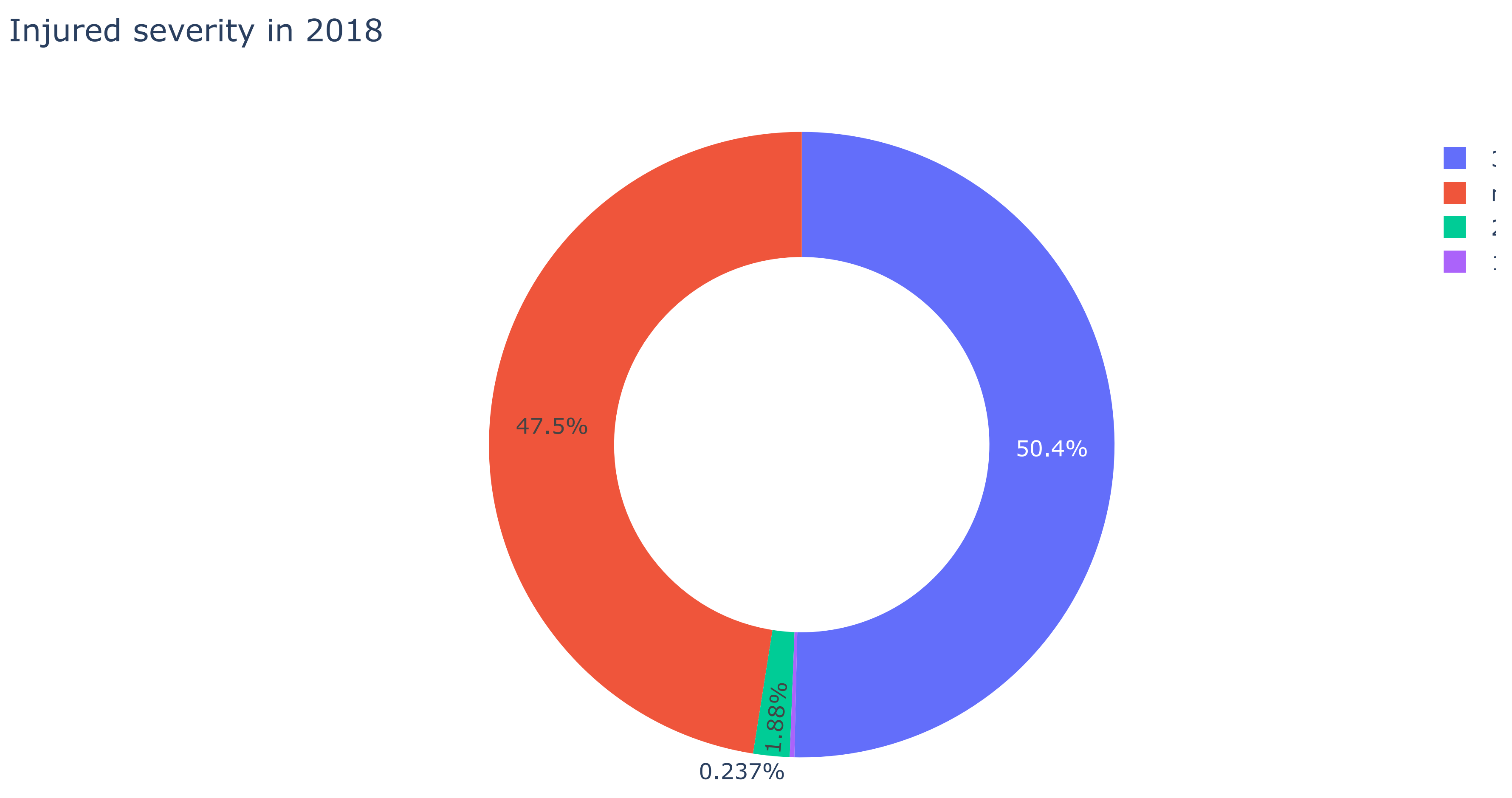
In [7]:
```python
from scipy.stats import pearsonr
import numpy as np
rho = df.corr().round(2)
pval = df.corr(method=lambda x, y: pearsonr(x, y)[1]) - np.eye(*rho.shape)
p = pval.applymap(lambda x: ''.join(['*' for t in [0.01,0.05,0.1] if x<=t]))
rho.astype(str) + p
```

Out[7]:

	age_group	sex	accident_hour	day_in_week	accident_district	accident_severity	isTelAviv
age_group	1.0***	0.01	-0.09***	-0.05***	0.01	0.01	0.03**
sex	0.01	1.0***	-0.03**	-0.04***	-0.01	0.07***	0.04***
accident_hour	-0.09***	-0.03**	1.0***	0.04***	-0.0	-0.0	-0.03***
day_in_week	-0.05***	-0.04***	0.04***	1.0***	0.03**	-0.05***	-0.01
accident_district	0.01	-0.01	-0.0	0.03**	1.0***	-0.13***	0.2***
accident_severity	0.01	0.07***	-0.0	-0.05***	-0.13***	1.0***	0.07***
isTelAviv	0.03**	0.04***	-0.03***	-0.01	0.2***	0.07***	1.0***

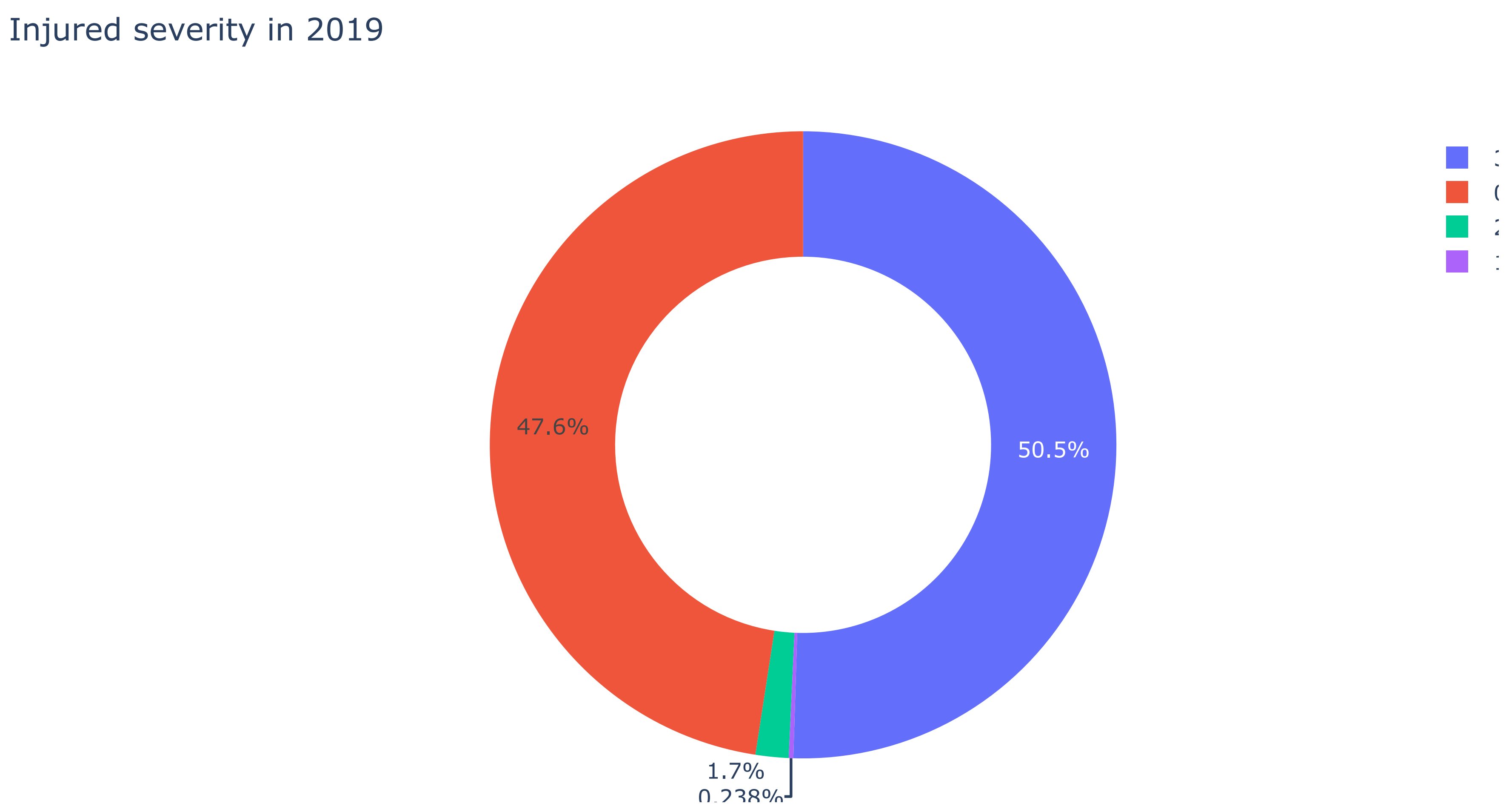
Year and injured severity

In [8]:
```python
df = df_main
df = df[df['Year'] == 2018]
Title = "Injured severity in 2018"
PlotPiechart(df['injury_severity'].values, df, 'Age')
df = df[df['injury_severity'] == 3]
print(len(df.index))
```



```
2026
```

```
In [9]: df = df_main
        df = df[df['Year'] == 2019]
        Title = "Injured severity in 2019"
        PlotPiechart(df['injury_severity'].values, df, 'Age')
        df = df[df['injury_severity'] == 3]
        print(len(df.index))
```



```
1805
```

Injury Severity

0.0 - Status Unknown

1.0 - dead / הרוג

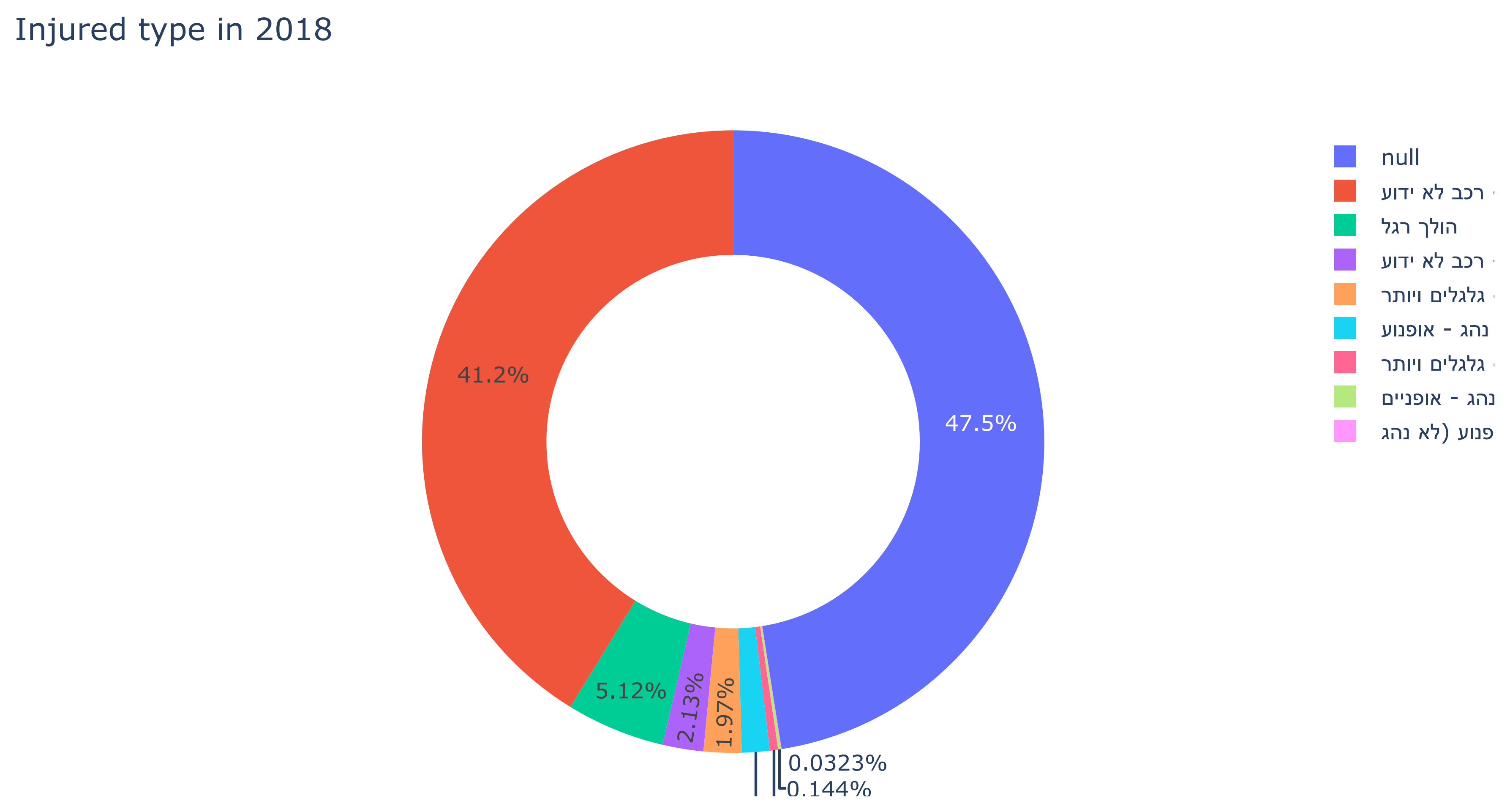
2.0 - Severly injured / פצוע קשה

3.0 - Slightly injured / פצוע קל

During Year 2019 fatal injuries showed a decrease !

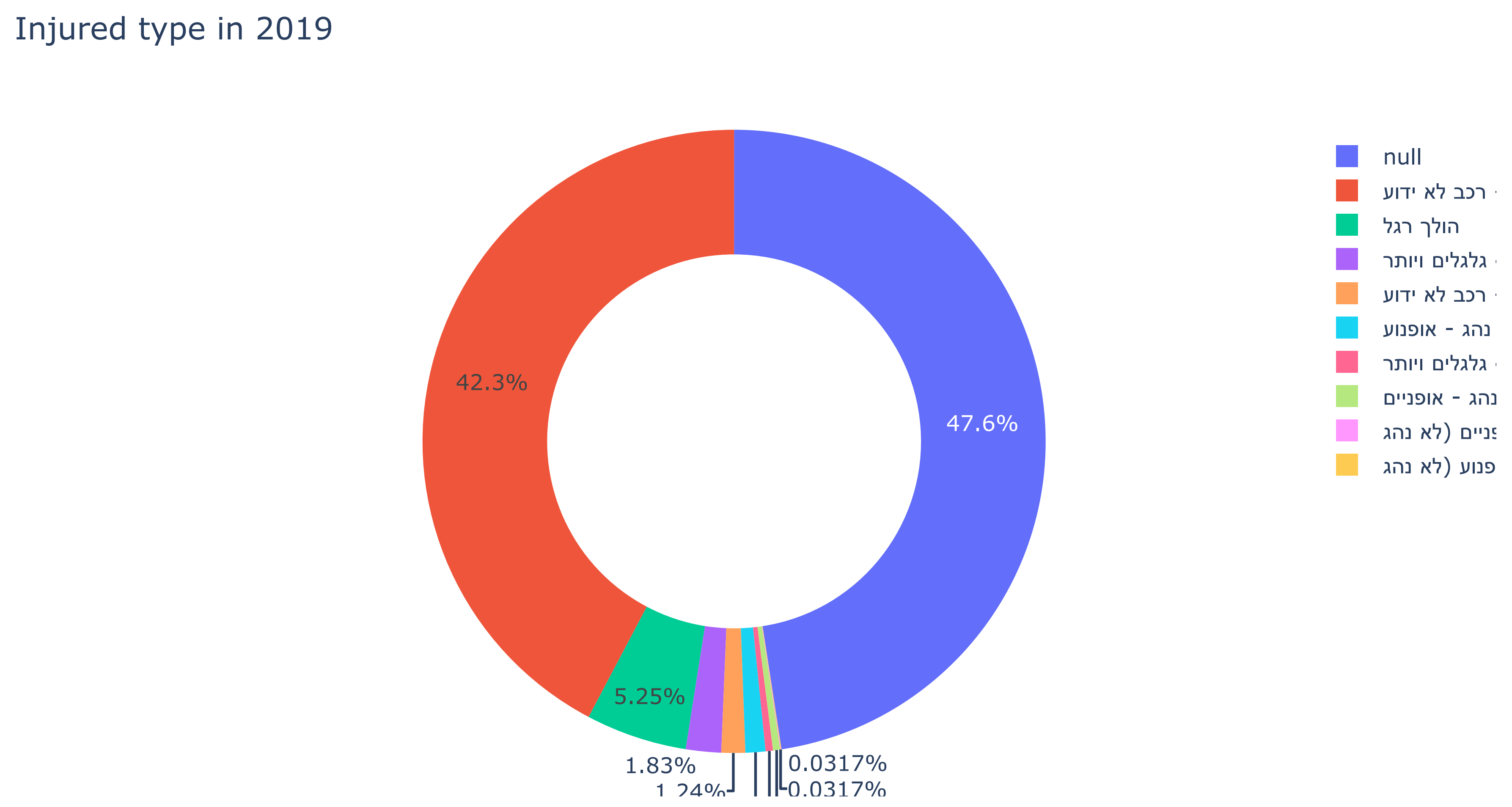
Year and injured type

```
In [10]: df = df_main
         df = df[df['Year'] == 2018]
         Title = "Injured type in 2018"
         PlotPiechart(df['injured_type_hebrew'].values, df, 'Age')
         df = df[df['injured_type'] == 1]
         print("number of pedestrians injured = {}".format(len(df.index)))
```



```
number of pedestrians injured = 215
```

```
In [11]: df = df_main
         df = df[df['Year'] == 2019]
         Title = "Injured type in 2019"
         PlotPiechart(df['injured_type_hebrew'].values, df, 'Age')
         df = df[df['injured_type'] == 1]
         print("number of pedestrians injured = {}".format(len(df.index)))
```



```
number of pedestrians injured = 193
```

Total Accident Count

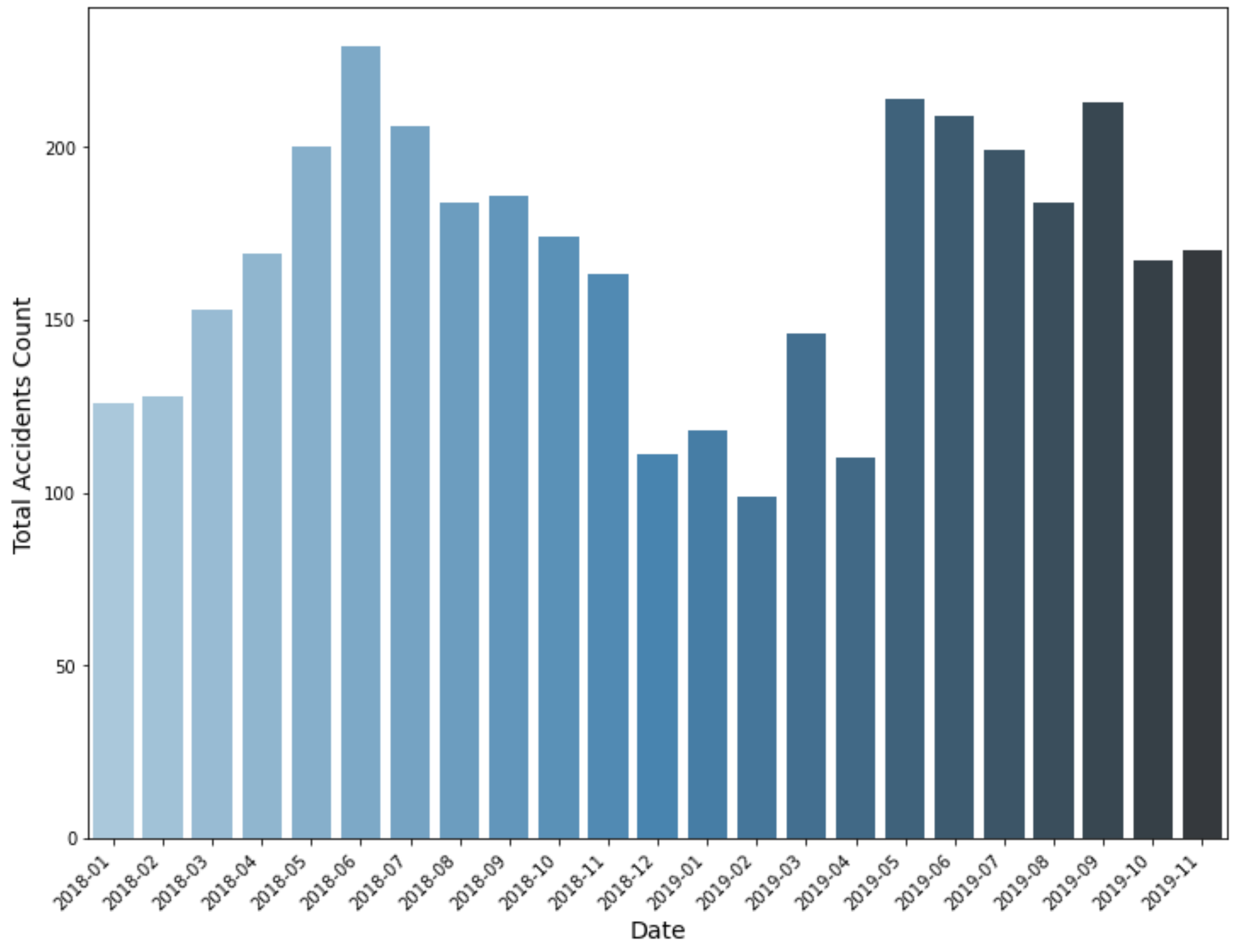
In [12]:
```
= df_main[['provider_and_id','Year','Month','Day']]
= df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'fir
= df.rename(columns={"provider_and_id":"Total Accidents Count"})

= df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
= df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')
```

Out[12]:

	Year	Month	Day	Total Accidents Count	Date
0	2018	1	1	126	2018-01-01
1	2018	2	1	128	2018-02-01
2	2018	3	1	153	2018-03-01
3	2018	4	1	169	2018-04-01
4	2018	5	1	200	2018-05-01
5	2018	6	1	229	2018-06-01
6	2018	7	1	206	2018-07-01
7	2018	8	1	184	2018-08-01
8	2018	9	1	186	2018-09-01
9	2018	10	1	174	2018-10-01
10	2018	11	1	163	2018-11-01
11	2018	12	1	111	2018-12-01
12	2019	1	1	118	2019-01-01
13	2019	2	1	99	2019-02-01
14	2019	3	1	146	2019-03-01
15	2019	4	1	110	2019-04-01
16	2019	5	1	214	2019-05-01
17	2019	6	1	209	2019-06-01
18	2019	7	1	199	2019-07-01
19	2019	8	1	184	2019-08-01
20	2019	9	1	213	2019-09-01
21	2019	10	1	167	2019-10-01
22	2019	11	1	170	2019-11-01

```
In [104]: fig, ax = plt.subplots(figsize = (12,9))
          fig = sns.lineplot(x='Date', y='Total Accidents Count', data=df, ax=ax)
          fig = sns.barplot(x="Date", y="Total Accidents Count", data = df,
                            ax=ax, palette="Blues_d")
          x_dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
          ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

```
Out[104]: [Text(0, 0, '2018-01'),
           Text(1, 0, '2018-02'),
           Text(2, 0, '2018-03'),
           Text(3, 0, '2018-04'),
           Text(4, 0, '2018-05'),
           Text(5, 0, '2018-06'),
           Text(6, 0, '2018-07'),
           Text(7, 0, '2018-08'),
           Text(8, 0, '2018-09'),
           Text(9, 0, '2018-10'),
           Text(10, 0, '2018-11'),
           Text(11, 0, '2018-12'),
           Text(12, 0, '2019-01'),
           Text(13, 0, '2019-02'),
           Text(14, 0, '2019-03'),
           Text(15, 0, '2019-04'),
           Text(16, 0, '2019-05'),
           Text(17, 0, '2019-06'),
           Text(18, 0, '2019-07'),
           Text(19, 0, '2019-08'),
           Text(20, 0, '2019-09'),
           Text(21, 0, '2019-10'),
           Text(22, 0, '2019-11')]
```



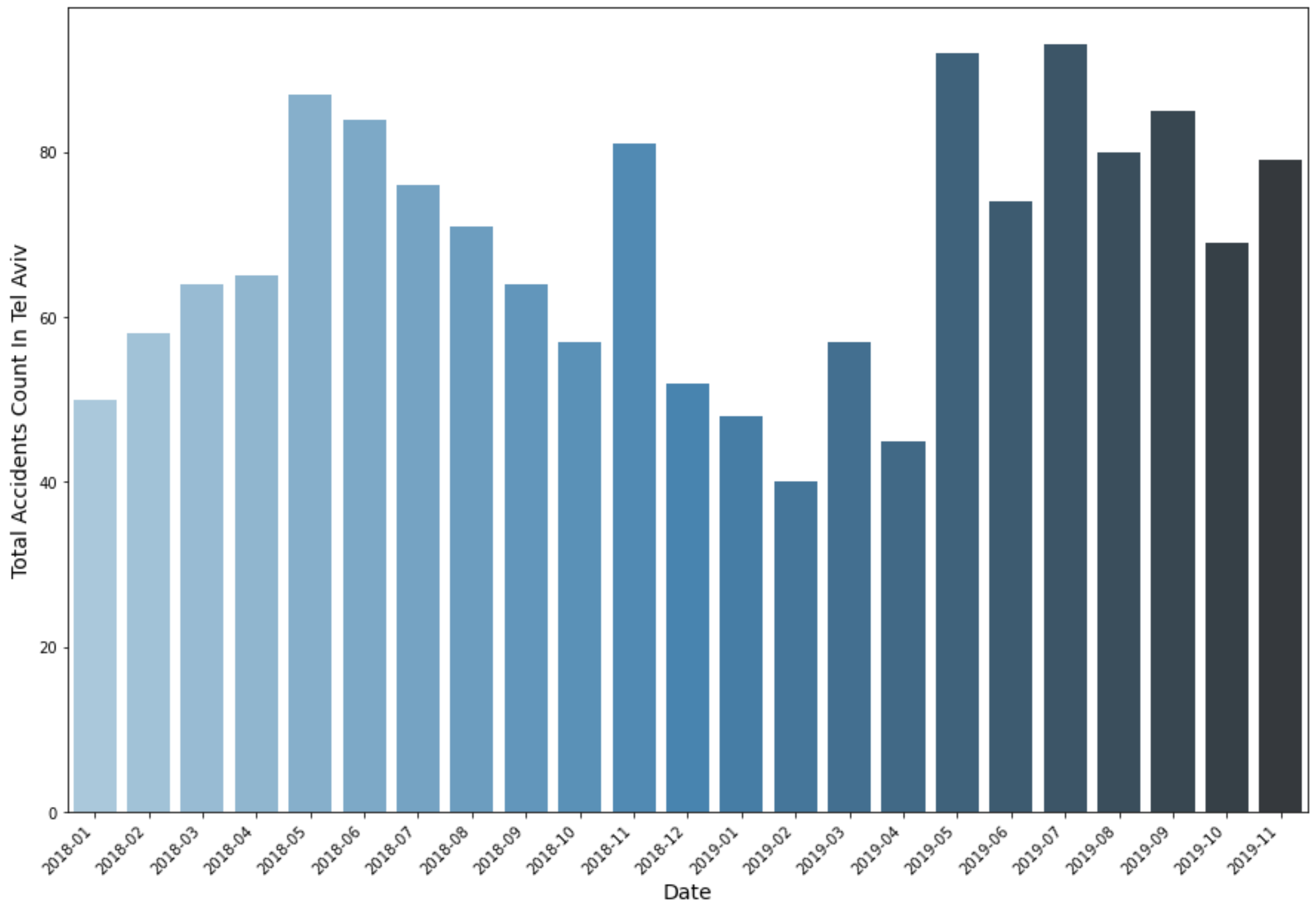
Accidents are at high level during summer seasons !

During Winter Seasons Accident are at their all time low

Inside Tel Aviv

```
In [36]: df = df_main[df_main['accident_region'] == 5]
         df = df[['provider_and_id','Year','Month','Day']]
         df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'
         df = df.rename(columns={"provider_and_id":"Total Accidents Count In Tel Aviv"})

         df = df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
         df = df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
         df["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')

         fig, ax = plt.subplots(figsize = (15,10))
         fig = sns.lineplot(x='Date', y='Total Accidents Count In Tel Aviv', data=df, ax=ax)
         fig = sns.barplot(x="Date", y="Total Accidents Count In Tel Aviv", data = df,
                           ax=ax, palette="Blues_d")
         x_dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
         ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

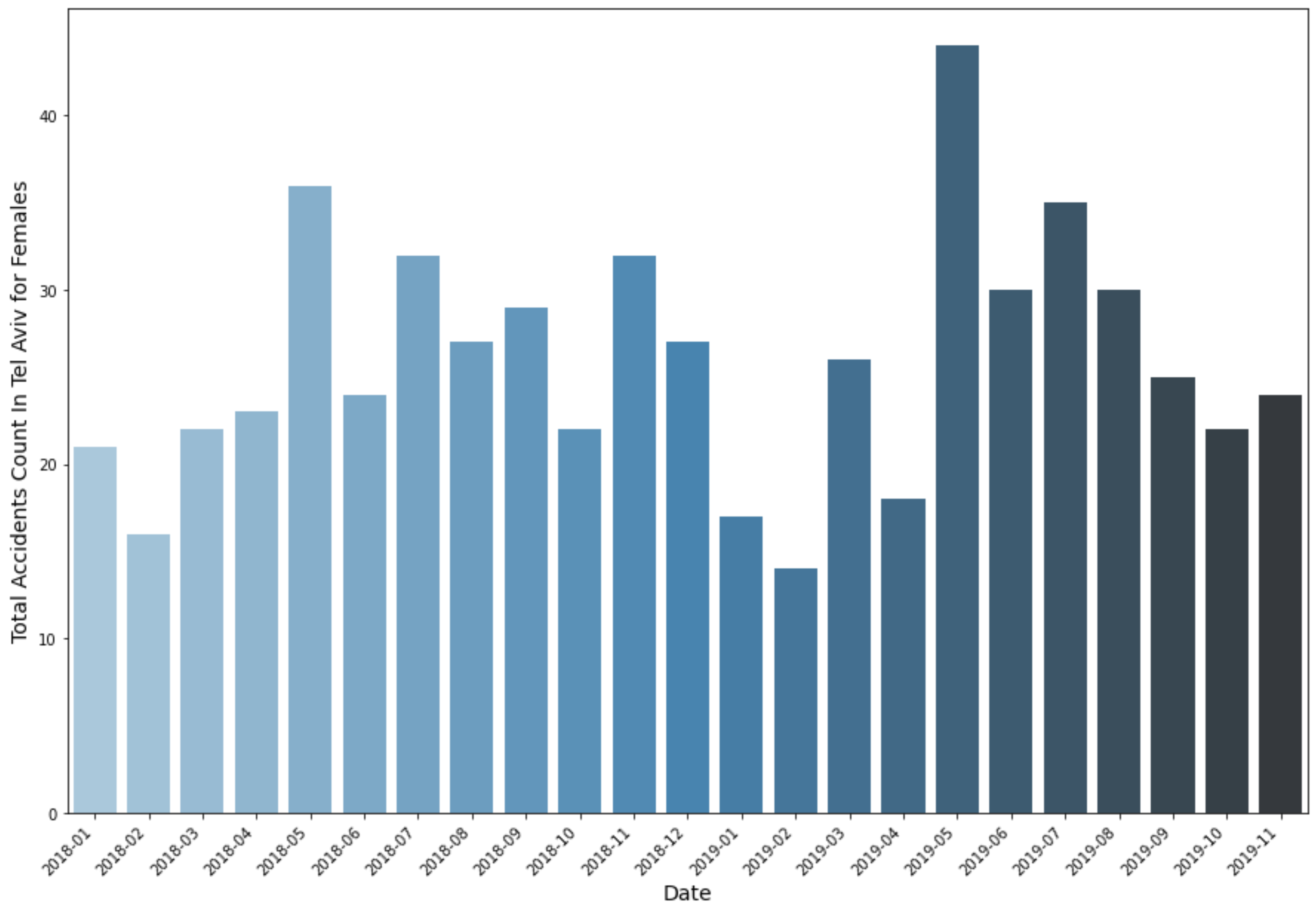
```
Out[36]: [Text(0, 0, '2018-01'),
          Text(1, 0, '2018-02'),
          Text(2, 0, '2018-03'),
          Text(3, 0, '2018-04'),
          Text(4, 0, '2018-05'),
          Text(5, 0, '2018-06'),
          Text(6, 0, '2018-07'),
          Text(7, 0, '2018-08'),
          Text(8, 0, '2018-09'),
          Text(9, 0, '2018-10'),
          Text(10, 0, '2018-11'),
          Text(11, 0, '2018-12'),
          Text(12, 0, '2019-01'),
          Text(13, 0, '2019-02'),
          Text(14, 0, '2019-03'),
          Text(15, 0, '2019-04'),
          Text(16, 0, '2019-05'),
          Text(17, 0, '2019-06'),
          Text(18, 0, '2019-07'),
          Text(19, 0, '2019-08'),
          Text(20, 0, '2019-09'),
          Text(21, 0, '2019-10'),
          Text(22, 0, '2019-11')]
```



Accidents count over time(Month) for females in Tel Aviv

```
In [35]: f = df_main[df_main['accident_region'] == 5]
         f = df[df['sex'] == 2]
         f = df[['provider_and_id','Year','Month','Day']]
         f = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'f
         f = df.rename(columns={"provider_and_id":"Total Accidents Count In Tel Aviv for Females"})

         f = df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
         f = df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
         f["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')

         ig, ax = plt.subplots(figsize = (15,10))
         ig = sns.lineplot(x='Date', y='Total Accidents Count In Tel Aviv for Females', data=df, ax=ax)
         ig = sns.barplot(x="Date", y="Total Accidents Count In Tel Aviv for Females", data = df,
                         ax=ax, palette="Blues_d")
         _dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
         x.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

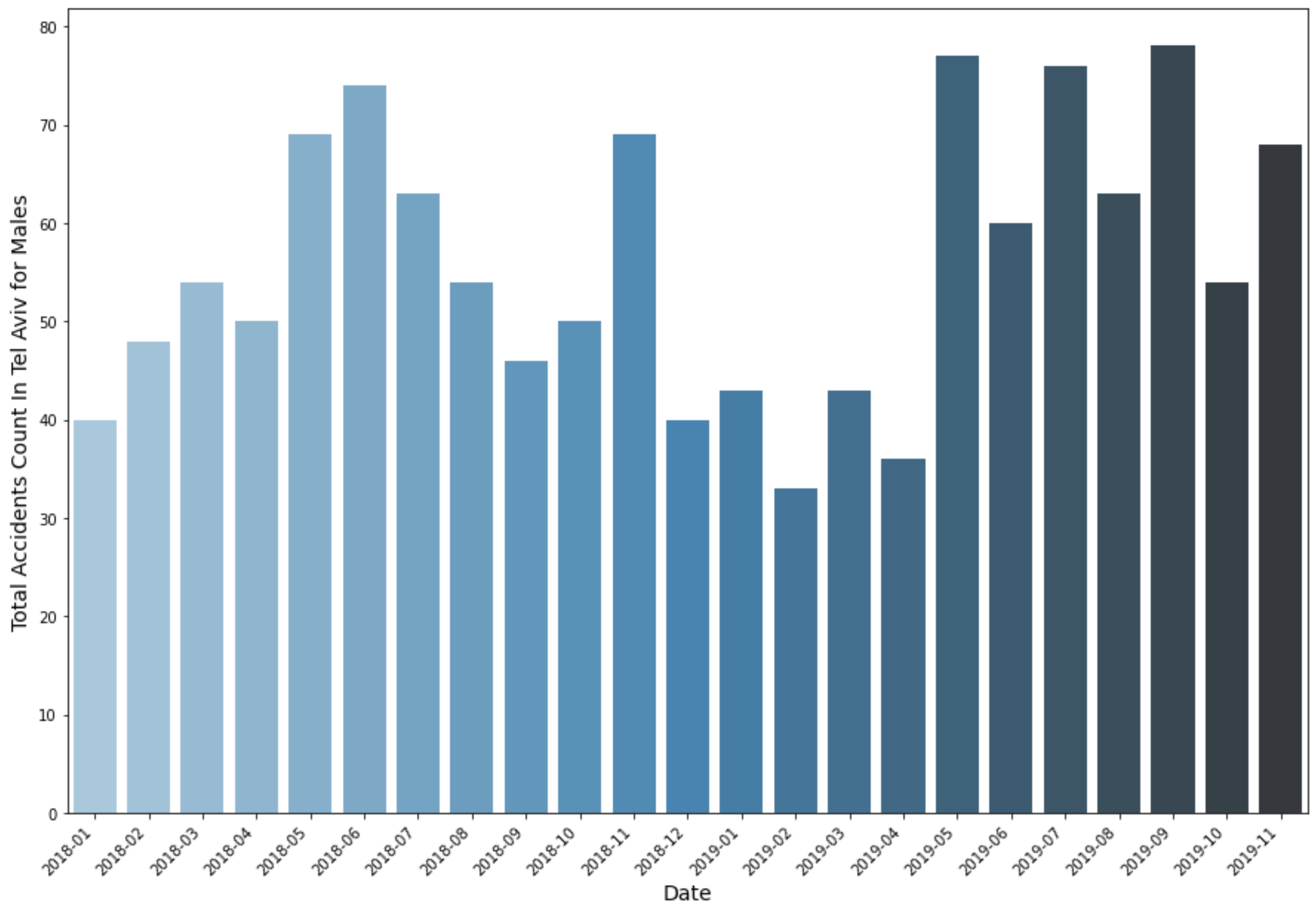
```
Out[35]: [Text(0, 0, '2018-01'),
          Text(1, 0, '2018-02'),
          Text(2, 0, '2018-03'),
          Text(3, 0, '2018-04'),
          Text(4, 0, '2018-05'),
          Text(5, 0, '2018-06'),
          Text(6, 0, '2018-07'),
          Text(7, 0, '2018-08'),
          Text(8, 0, '2018-09'),
          Text(9, 0, '2018-10'),
          Text(10, 0, '2018-11'),
          Text(11, 0, '2018-12'),
          Text(12, 0, '2019-01'),
          Text(13, 0, '2019-02'),
          Text(14, 0, '2019-03'),
          Text(15, 0, '2019-04'),
          Text(16, 0, '2019-05'),
          Text(17, 0, '2019-06'),
          Text(18, 0, '2019-07'),
          Text(19, 0, '2019-08'),
          Text(20, 0, '2019-09'),
          Text(21, 0, '2019-10'),
          Text(22, 0, '2019-11')]
```



Accidents count over time(Month) for males in Tel Aviv

In [34]:
```python
df = df_main[df_main['accident_region'] == 5]
df = df[df['sex'] == 1]
df = df[['provider_and_id','Year','Month','Day']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'
df = df.rename(columns={"provider_and_id":"Total Accidents Count In Tel Aviv for Males"})

df = df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
df = df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
df["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')

fig, ax = plt.subplots(figsize = (15,10))
fig = sns.lineplot(x='Date', y='Total Accidents Count In Tel Aviv for Males', data=df, ax=ax)
fig = sns.barplot(x="Date", y="Total Accidents Count In Tel Aviv for Males", data = df,
                  ax=ax, palette="Blues_d")
x_dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

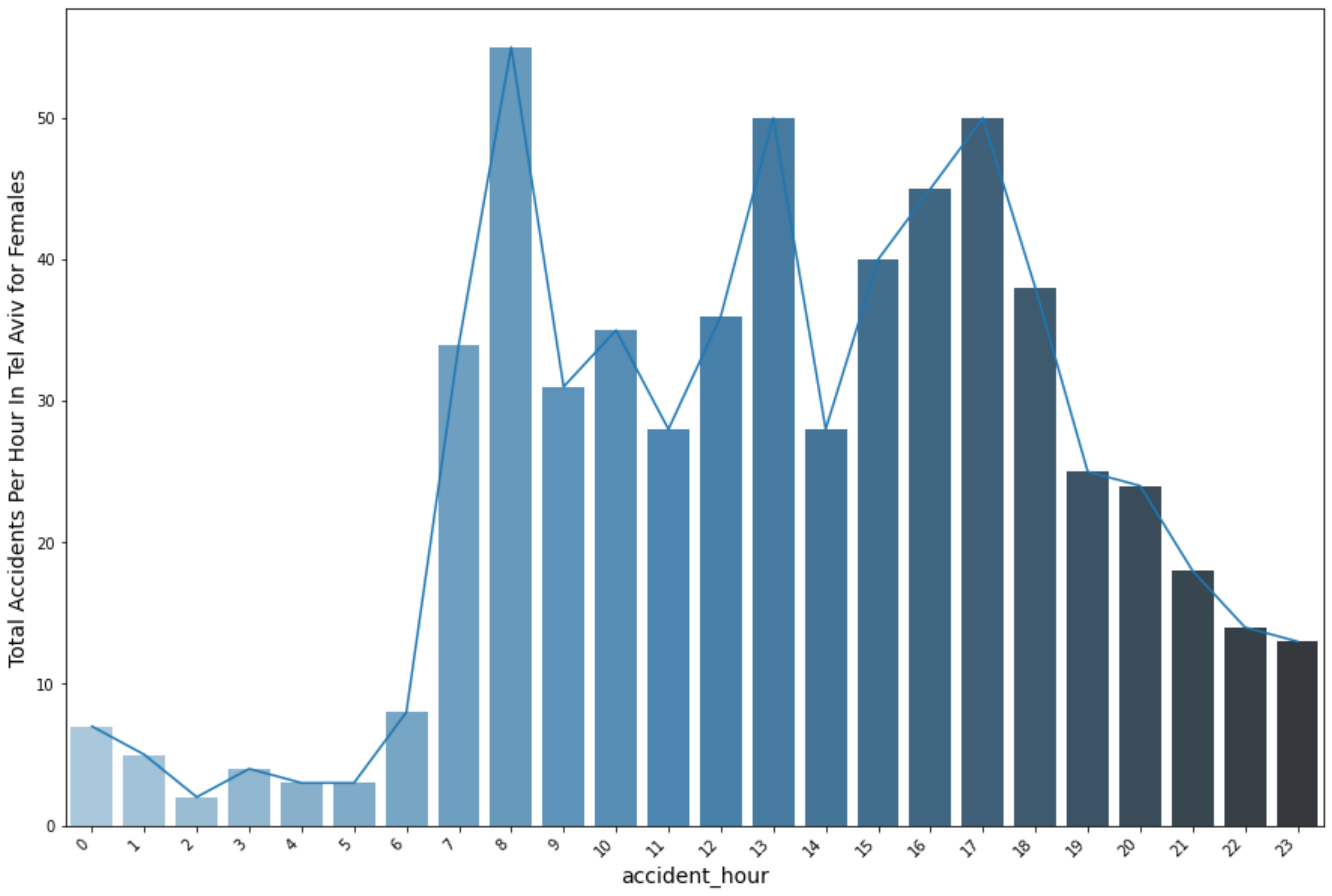
Out[34]:
```
[Text(0, 0, '2018-01'),
 Text(1, 0, '2018-02'),
 Text(2, 0, '2018-03'),
 Text(3, 0, '2018-04'),
 Text(4, 0, '2018-05'),
 Text(5, 0, '2018-06'),
 Text(6, 0, '2018-07'),
 Text(7, 0, '2018-08'),
 Text(8, 0, '2018-09'),
 Text(9, 0, '2018-10'),
 Text(10, 0, '2018-11'),
 Text(11, 0, '2018-12'),
 Text(12, 0, '2019-01'),
 Text(13, 0, '2019-02'),
 Text(14, 0, '2019-03'),
 Text(15, 0, '2019-04'),
 Text(16, 0, '2019-05'),
 Text(17, 0, '2019-06'),
 Text(18, 0, '2019-07'),
 Text(19, 0, '2019-08'),
 Text(20, 0, '2019-09'),
 Text(21, 0, '2019-10'),
 Text(22, 0, '2019-11')]
```



Accidents count over time(Hourly) for females in Tel Aviv

In [55]:
```python
df = df_main[df_main['accident_region'] == 5] # Tel Aviv
df = df[df['sex'] == 2] # Females
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In Tel Aviv for Females"})

df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df = df.sort_values(by=['accident_hour']).reset_index(drop=True)

fig, ax = plt.subplots(figsize = (15,10))
fig = sns.lineplot(x='accident_hour', y='Total Accidents Per Hour In Tel Aviv for Females', data=df, ax=
fig = sns.barplot(x="accident_hour", y="Total Accidents Per Hour In Tel Aviv for Females", data = df,
                  ax=ax, palette="Blues_d")
x_dates = df['accident_hour'].sort_values().unique()
ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

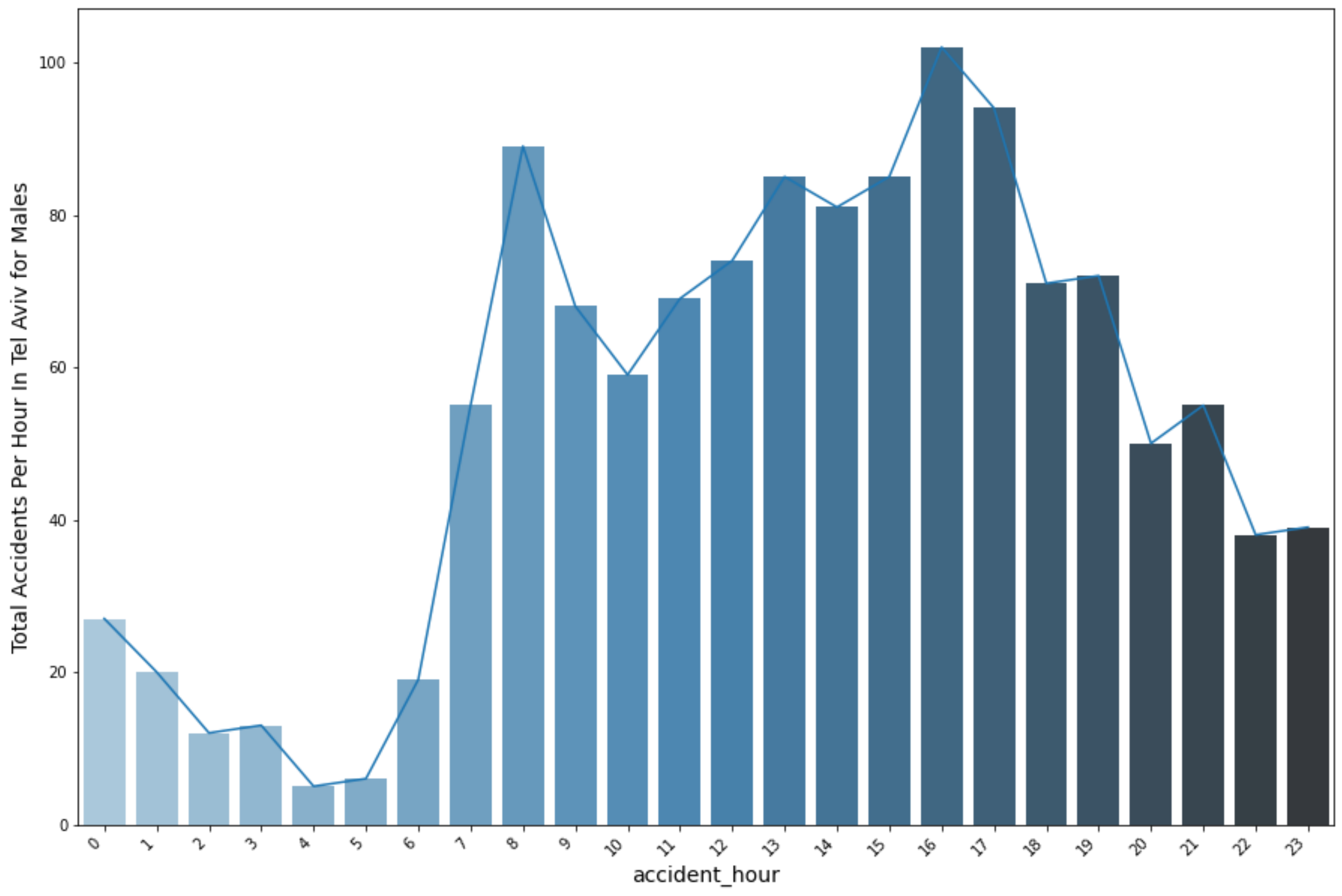
Out[55]:
```
[Text(0, 0, '0'),
 Text(1, 0, '1'),
 Text(2, 0, '2'),
 Text(3, 0, '3'),
 Text(4, 0, '4'),
 Text(5, 0, '5'),
 Text(6, 0, '6'),
 Text(7, 0, '7'),
 Text(8, 0, '8'),
 Text(9, 0, '9'),
 Text(10, 0, '10'),
 Text(11, 0, '11'),
 Text(12, 0, '12'),
 Text(13, 0, '13'),
 Text(14, 0, '14'),
 Text(15, 0, '15'),
 Text(16, 0, '16'),
 Text(17, 0, '17'),
 Text(18, 0, '18'),
 Text(19, 0, '19'),
 Text(20, 0, '20'),
 Text(21, 0, '21'),
 Text(22, 0, '22'),
 Text(23, 0, '23')]
```



Accidents count over time(Hourly) for males in Tel Aviv

```
In [58]: df = df_main[df_main['accident_region'] == 5] # Tel Aviv
         df = df[df['sex'] == 1] # Males
         df = df[['provider_and_id','accident_hour']]
         df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
         df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In Tel Aviv for Males"})

         df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
         df = df.sort_values(by=['accident_hour']).reset_index(drop=True)

         fig, ax = plt.subplots(figsize = (15,10))
         fig = sns.lineplot(x='accident_hour', y='Total Accidents Per Hour In Tel Aviv for Males', data=df, ax=ax
         fig = sns.barplot(x="accident_hour", y="Total Accidents Per Hour In Tel Aviv for Males", data = df,
                           ax=ax, palette="Blues_d")
         x_dates = df['accident_hour'].sort_values().unique()
         ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

```
Out[58]: [Text(0, 0, '0'),
          Text(1, 0, '1'),
          Text(2, 0, '2'),
          Text(3, 0, '3'),
          Text(4, 0, '4'),
          Text(5, 0, '5'),
          Text(6, 0, '6'),
          Text(7, 0, '7'),
          Text(8, 0, '8'),
          Text(9, 0, '9'),
          Text(10, 0, '10'),
          Text(11, 0, '11'),
          Text(12, 0, '12'),
          Text(13, 0, '13'),
          Text(14, 0, '14'),
          Text(15, 0, '15'),
          Text(16, 0, '16'),
          Text(17, 0, '17'),
          Text(18, 0, '18'),
          Text(19, 0, '19'),
          Text(20, 0, '20'),
          Text(21, 0, '21'),
          Text(22, 0, '22'),
          Text(23, 0, '23')]
```

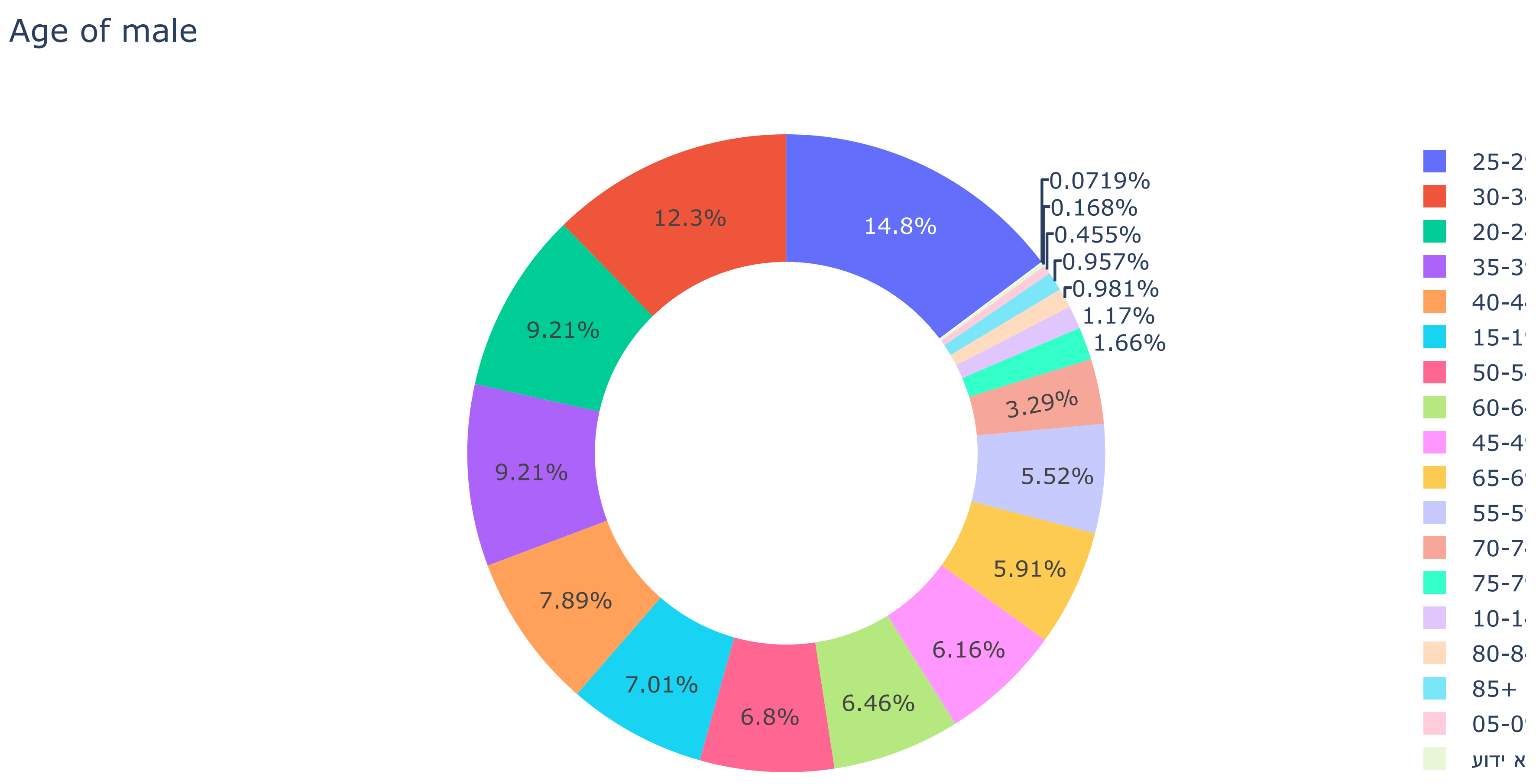


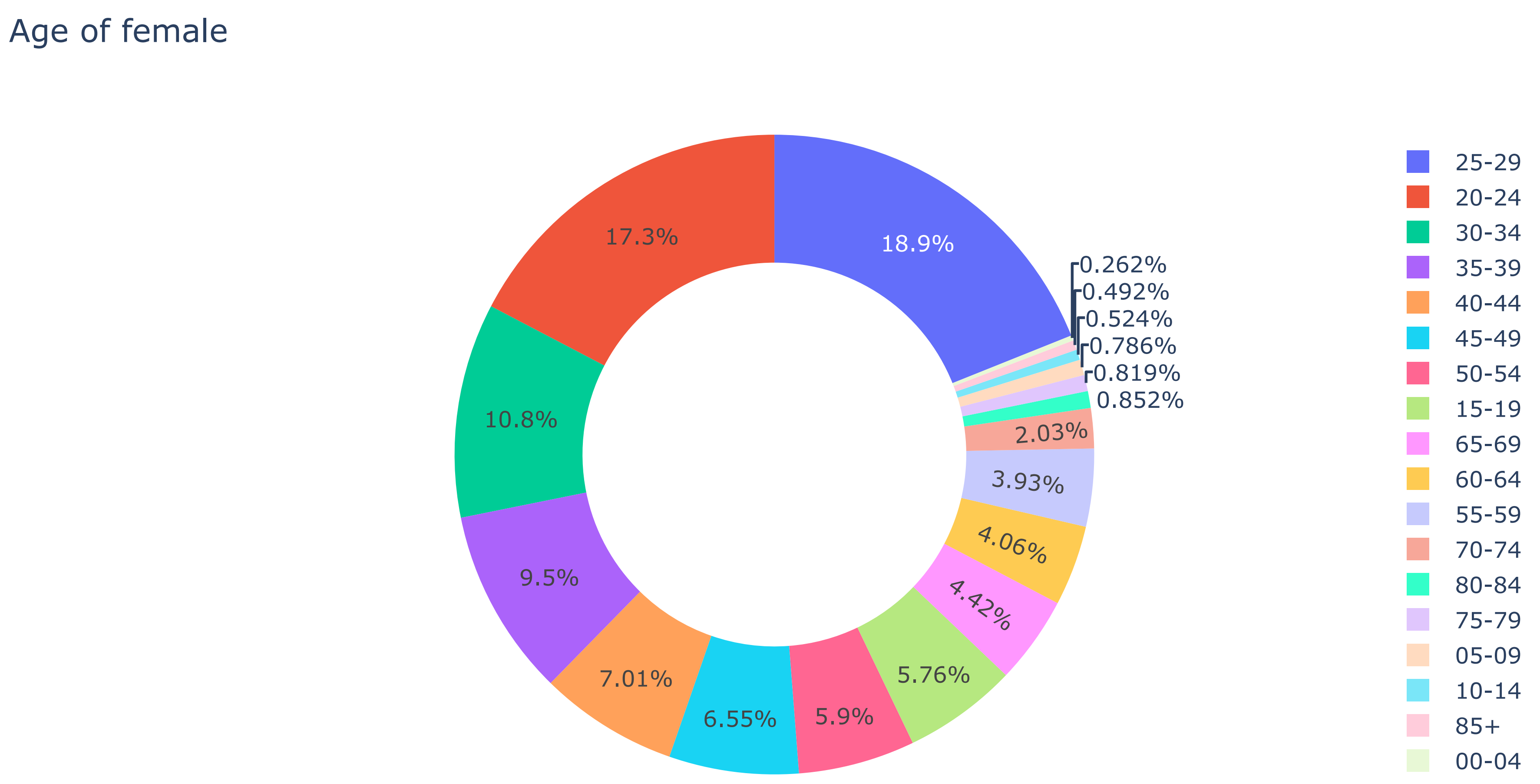
Maximum Accidents occurs during ofice hours !

8 am usually maximum accident occurs

Age

```
In [13]: # age by gender
         df = df_main[df_main['accident_region'] == 5] # Tel Aviv

         # we take only accidents with full gender data
         indecies = df['sex_hebrew'].isna()
         p_and_id = df[indecies]['provider_and_id'].to_numpy()
         df_gender = df[df['provider_and_id'].map(lambda x: x not in p_and_id)]

         df1 = df_gender[df_gender['sex'] == 1] # male
         Title = "Age of male"
         PlotPiechart(df1['age_group_hebrew'].values, df1, 'Age')

         df2 = df_gender[df_gender['sex'] == 2] # female
         Title = "Age of female"
         PlotPiechart(df2['age_group_hebrew'].values, df2, 'Age')
```





Young Adults are more involved in Accidents !

In [60]:
```
# age by gender
df = df_main[df_main['accident_region'] == 5] # Tel Aviv

# we take only accidents with full gender data
indecies = df['sex_hebrew'].isna()
p_and_id = df[indecies]['provider_and_id'].to_numpy()
df_gender = df[df['provider_and_id'].map(lambda x: x not in p_and_id)]

df1 = df_gender[df_gender['sex'] == 1] # male
df_male_age = df1['age_group'].values

# age by gender
df = df_main[df_main['accident_region'] == 5] # Tel Aviv

# we take only accidents with full gender data
indecies = df['sex_hebrew'].isna()
p_and_id = df[indecies]['provider_and_id'].to_numpy()
df_gender = df[df['provider_and_id'].map(lambda x: x not in p_and_id)]

df1 = df_gender[df_gender['sex'] == 2] # female
df_female_age = df1['age_group'].values

from scipy.stats import ttest_ind

male_mean = np.mean(df_male_age)
female_mean = np.mean(df_female_age)
print("male mean value:",male_mean)
print("female mean value:",female_mean)
male_std = np.std(df_male_age)
female_std = np.std(df_female_age)
print("man std value:",male_std)
print("female std value:",female_std)
ttest,pval = ttest_ind(df_male_age,df_female_age)
print("p-value",pval)
if pval <0.05:
  print("we reject null hypothesis")
else:
  print("we accept null hypothesis")
```

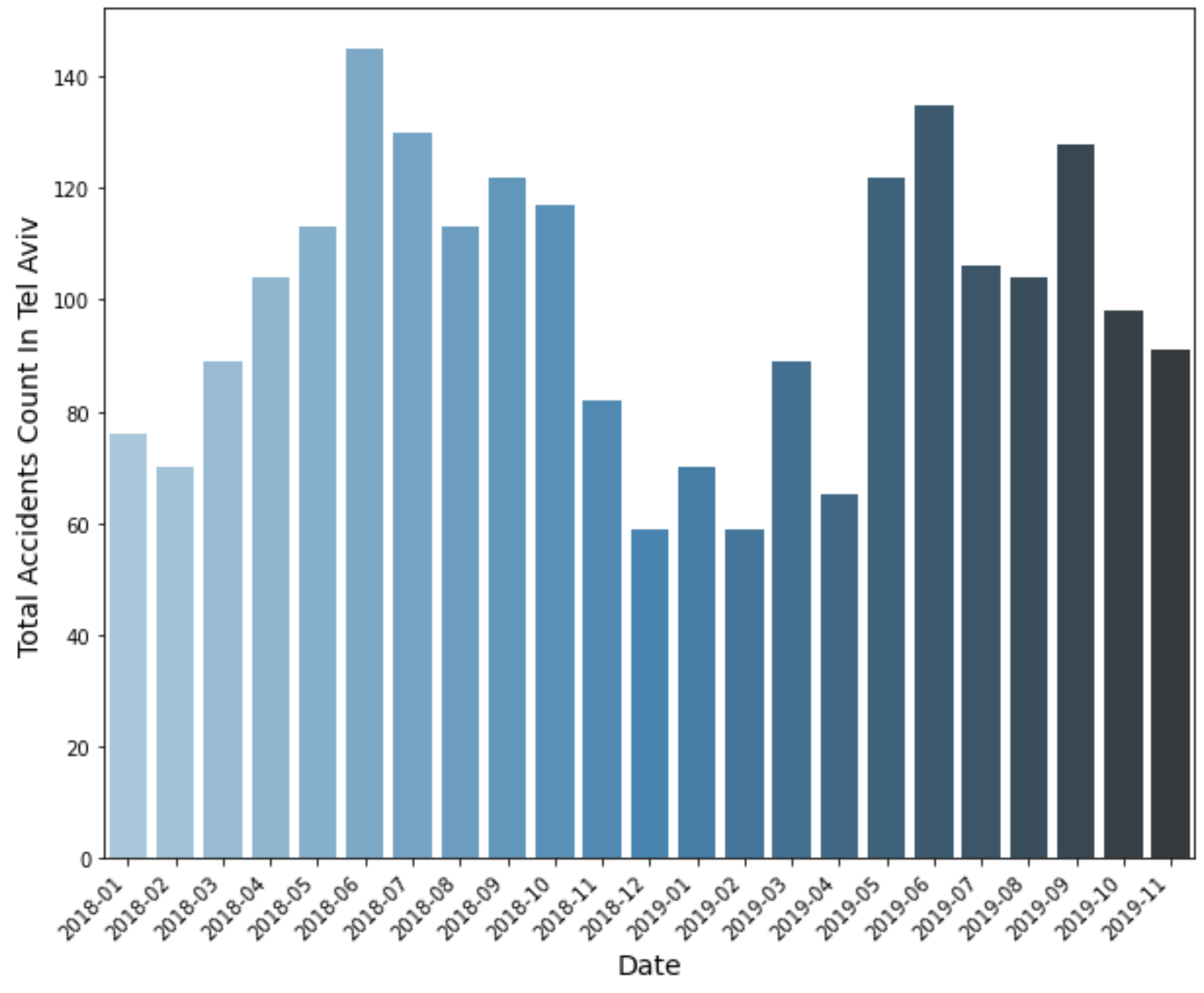
```
male mean value: 8.989544436146378
female mean value: 8.123142250530785
man std value: 5.589508844951088
female std value: 3.4081386759552283
p-value 0.0015942335410290042
we reject null hypothesis
```

Outside of Tel Aviv

All Accidents count over time

```
In [64]:  = df_main[df_main['accident_region'] != 5]
          = df[['provider_and_id','Year','Month','Day']]
          = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'fi
          = df.rename(columns={"provider_and_id":"Total Accidents Count In Tel Aviv"})

          = df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
          = df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
         ["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')

         g, ax = plt.subplots(figsize = (10,8))
         g = sns.lineplot(x='Date', y='Total Accidents Count In Tel Aviv', data=df, ax=ax)
         g = sns.barplot(x="Date", y="Total Accidents Count In Tel Aviv", data = df,
                         ax=ax, palette="Blues_d")
         dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
         .set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

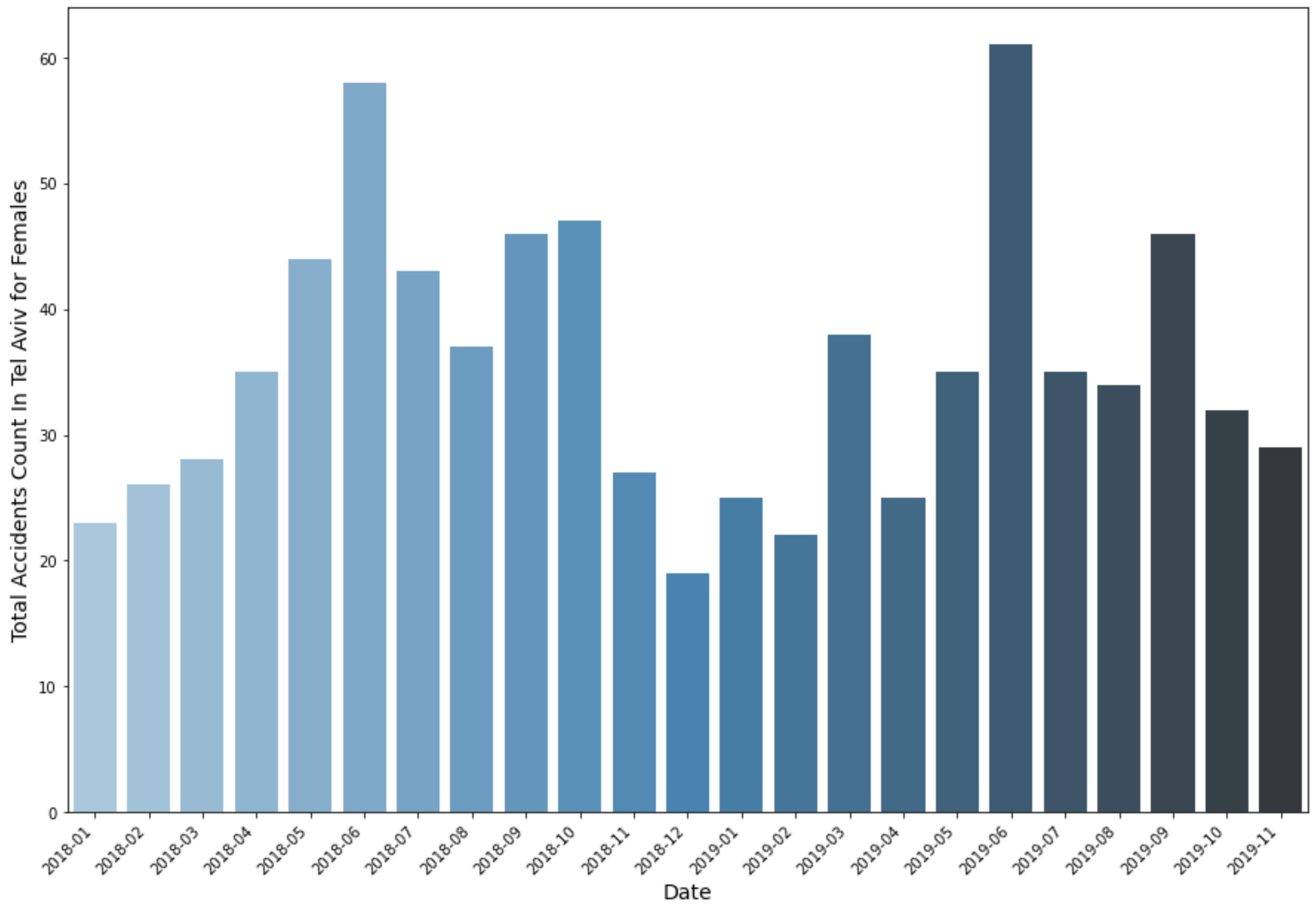
```
Out[64]: [Text(0, 0, '2018-01'),
          Text(1, 0, '2018-02'),
          Text(2, 0, '2018-03'),
          Text(3, 0, '2018-04'),
          Text(4, 0, '2018-05'),
          Text(5, 0, '2018-06'),
          Text(6, 0, '2018-07'),
          Text(7, 0, '2018-08'),
          Text(8, 0, '2018-09'),
          Text(9, 0, '2018-10'),
          Text(10, 0, '2018-11'),
          Text(11, 0, '2018-12'),
          Text(12, 0, '2019-01'),
          Text(13, 0, '2019-02'),
          Text(14, 0, '2019-03'),
          Text(15, 0, '2019-04'),
          Text(16, 0, '2019-05'),
          Text(17, 0, '2019-06'),
          Text(18, 0, '2019-07'),
          Text(19, 0, '2019-08'),
          Text(20, 0, '2019-09'),
          Text(21, 0, '2019-10'),
          Text(22, 0, '2019-11')]
```



Accidents count over time(Month) for females Outside Tel Aviv

In [63]:
```python
df = df_main[df_main['accident_region'] != 5]
df = df[df['sex'] == 2]
df = df[['provider_and_id','Year','Month','Day']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'
df = df.rename(columns={"provider_and_id":"Total Accidents Count In Tel Aviv for Females"})

df = df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
df = df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
df["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')

fig, ax = plt.subplots(figsize = (15,10))
fig = sns.lineplot(x='Date', y='Total Accidents Count In Tel Aviv for Females', data=df, ax=ax)
fig = sns.barplot(x="Date", y="Total Accidents Count In Tel Aviv for Females", data = df,
                  ax=ax, palette="Blues_d")
x_dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

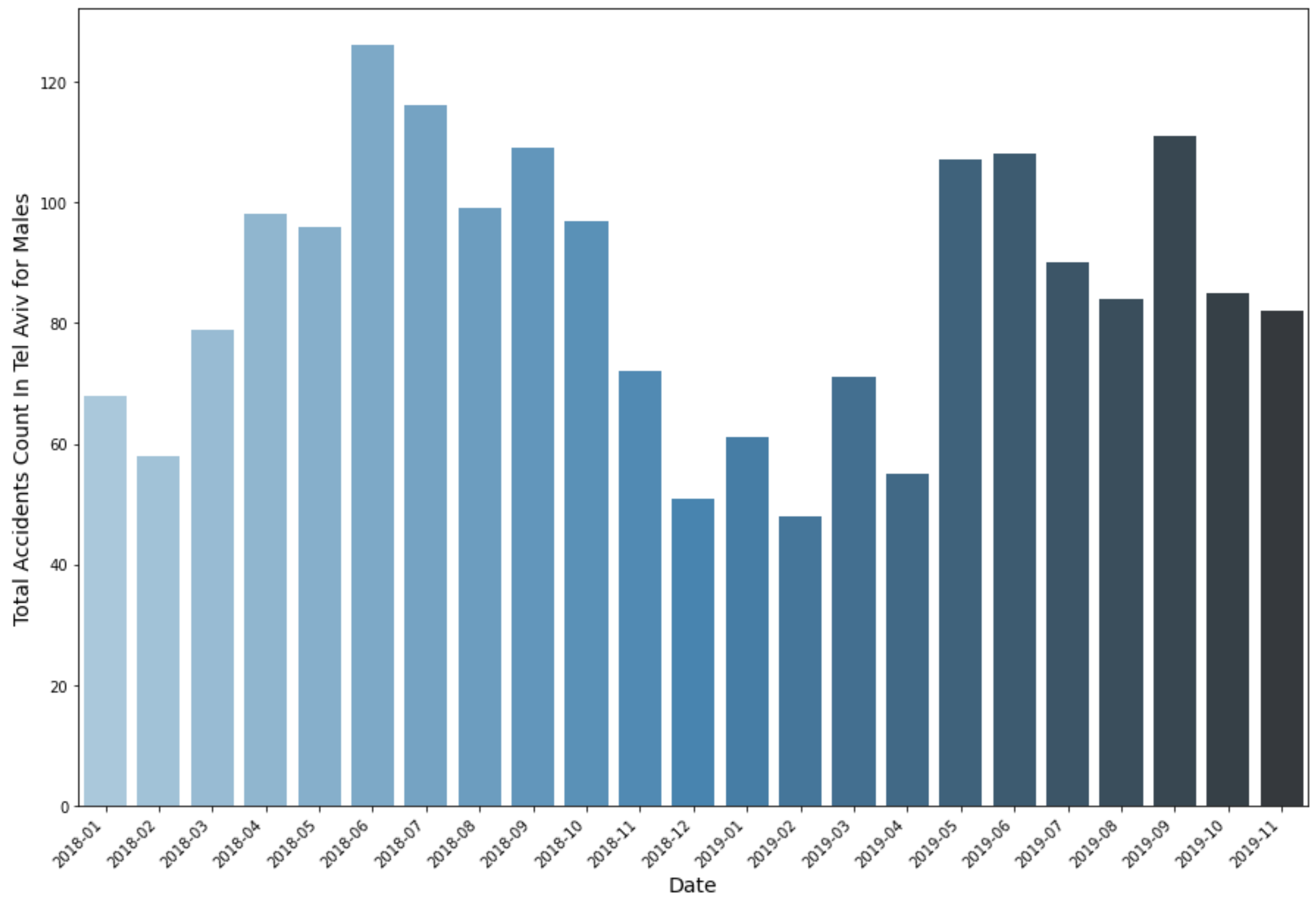
Out[63]:
```
[Text(0, 0, '2018-01'),
 Text(1, 0, '2018-02'),
 Text(2, 0, '2018-03'),
 Text(3, 0, '2018-04'),
 Text(4, 0, '2018-05'),
 Text(5, 0, '2018-06'),
 Text(6, 0, '2018-07'),
 Text(7, 0, '2018-08'),
 Text(8, 0, '2018-09'),
 Text(9, 0, '2018-10'),
 Text(10, 0, '2018-11'),
 Text(11, 0, '2018-12'),
 Text(12, 0, '2019-01'),
 Text(13, 0, '2019-02'),
 Text(14, 0, '2019-03'),
 Text(15, 0, '2019-04'),
 Text(16, 0, '2019-05'),
 Text(17, 0, '2019-06'),
 Text(18, 0, '2019-07'),
 Text(19, 0, '2019-08'),
 Text(20, 0, '2019-09'),
 Text(21, 0, '2019-10'),
 Text(22, 0, '2019-11')]
```



Accidents count over time(Month) for males Outside Tel Aviv

```
In [65]: f = df_main[df_main['accident_region'] != 5]
         f = df[df['sex'] == 1]
         f = df[['provider_and_id','Year','Month','Day']]
         f = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'Year':'first','Month':'fi
         f = df.rename(columns={"provider_and_id":"Total Accidents Count In Tel Aviv for Males"})

         f = df.set_index(['Year','Month','Day']).sum(level=[0,1,2]).reset_index()
         f = df.sort_values(by=['Year','Month','Day']).reset_index(drop=True)
         f["Date"] = pd.to_datetime(df[['Year', 'Month', 'Day',]],format='%Y%m%d')

         ig, ax = plt.subplots(figsize = (15,10))
         ig = sns.lineplot(x='Date', y='Total Accidents Count In Tel Aviv for Males', data=df, ax=ax)
         ig = sns.barplot(x="Date", y="Total Accidents Count In Tel Aviv for Males", data = df,
                          ax=ax, palette="Blues_d")
         _dates = df['Date'].dt.strftime('%Y-%m').sort_values().unique()
         x.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

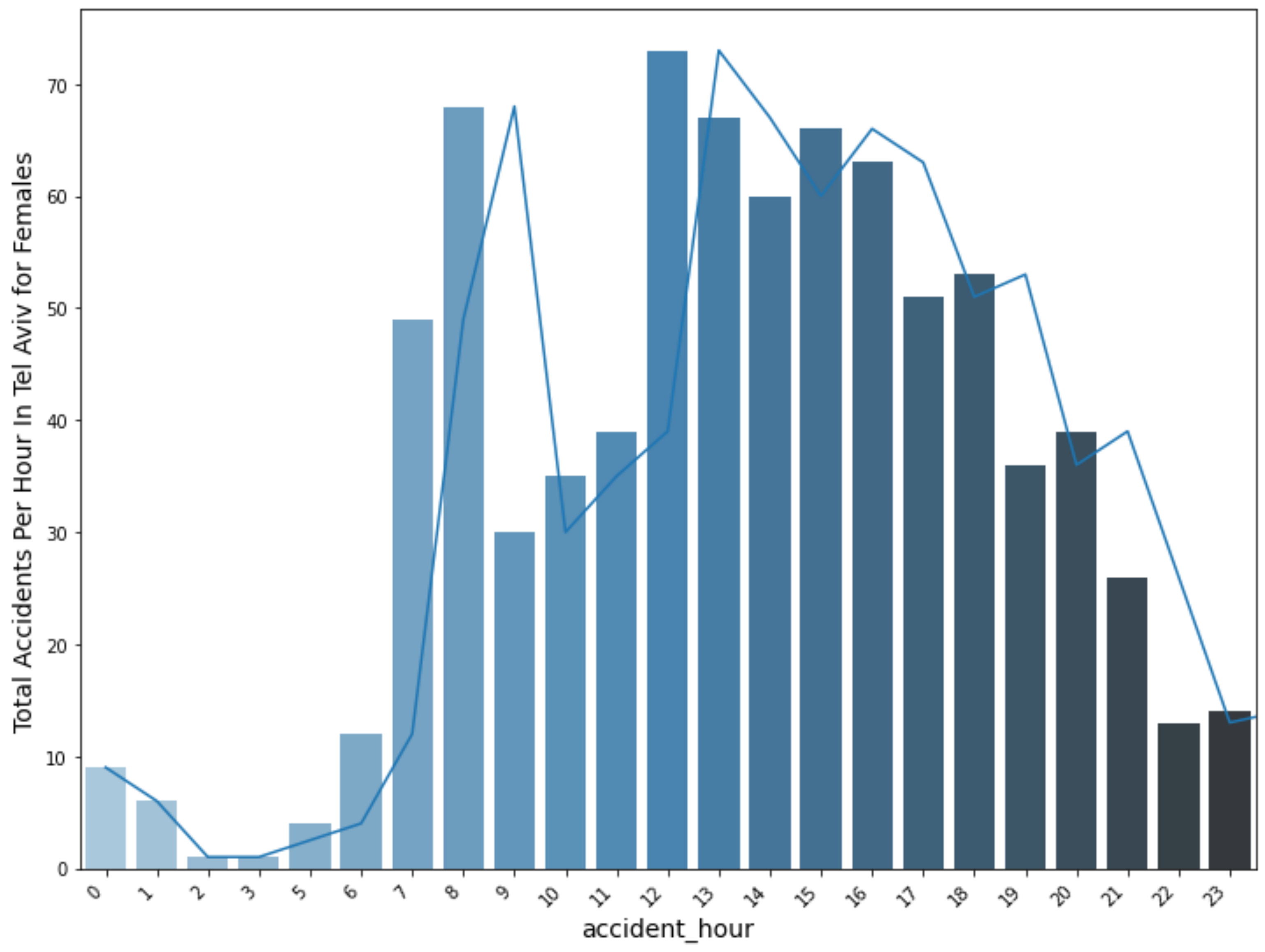
```
Out[65]: [Text(0, 0, '2018-01'),
          Text(1, 0, '2018-02'),
          Text(2, 0, '2018-03'),
          Text(3, 0, '2018-04'),
          Text(4, 0, '2018-05'),
          Text(5, 0, '2018-06'),
          Text(6, 0, '2018-07'),
          Text(7, 0, '2018-08'),
          Text(8, 0, '2018-09'),
          Text(9, 0, '2018-10'),
          Text(10, 0, '2018-11'),
          Text(11, 0, '2018-12'),
          Text(12, 0, '2019-01'),
          Text(13, 0, '2019-02'),
          Text(14, 0, '2019-03'),
          Text(15, 0, '2019-04'),
          Text(16, 0, '2019-05'),
          Text(17, 0, '2019-06'),
          Text(18, 0, '2019-07'),
          Text(19, 0, '2019-08'),
          Text(20, 0, '2019-09'),
          Text(21, 0, '2019-10'),
          Text(22, 0, '2019-11')]
```



Accidents count over time(Hourly) for females Outside Tel Aviv

```
In [68]: df = df_main[df_main['accident_region'] != 5] # Tel Aviv
         df = df[df['sex'] == 2] # Females
         df = df[['provider_and_id','accident_hour']]
         df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
         df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In Tel Aviv for Females"})

         df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
         df = df.sort_values(by=['accident_hour']).reset_index(drop=True)

         fig, ax = plt.subplots(figsize = (12,9))
         fig = sns.lineplot(x='accident_hour', y='Total Accidents Per Hour In Tel Aviv for Females', data=df, ax=
         fig = sns.barplot(x="accident_hour", y="Total Accidents Per Hour In Tel Aviv for Females", data = df,
                           ax=ax, palette="Blues_d")
         x_dates = df['accident_hour'].sort_values().unique()
         ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

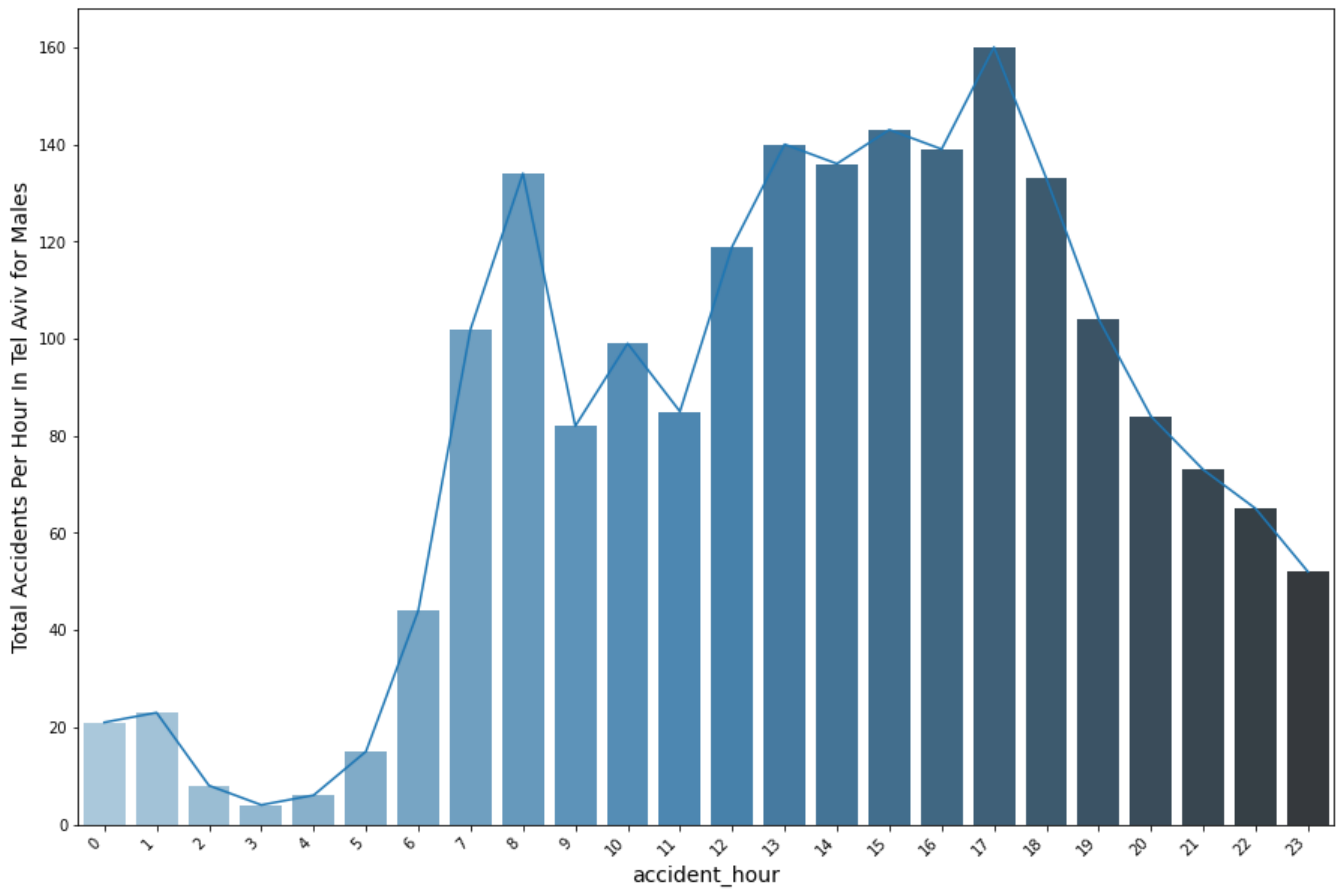
```
Out[68]: [Text(0, 0, '0'),
          Text(1, 0, '1'),
          Text(2, 0, '2'),
          Text(3, 0, '3'),
          Text(4, 0, '5'),
          Text(5, 0, '6'),
          Text(6, 0, '7'),
          Text(7, 0, '8'),
          Text(8, 0, '9'),
          Text(9, 0, '10'),
          Text(10, 0, '11'),
          Text(11, 0, '12'),
          Text(12, 0, '13'),
          Text(13, 0, '14'),
          Text(14, 0, '15'),
          Text(15, 0, '16'),
          Text(16, 0, '17'),
          Text(17, 0, '18'),
          Text(18, 0, '19'),
          Text(19, 0, '20'),
          Text(20, 0, '21'),
          Text(21, 0, '22'),
          Text(22, 0, '23')]
```



Accidents count over time(Hourly) for males Outside Tel Aviv

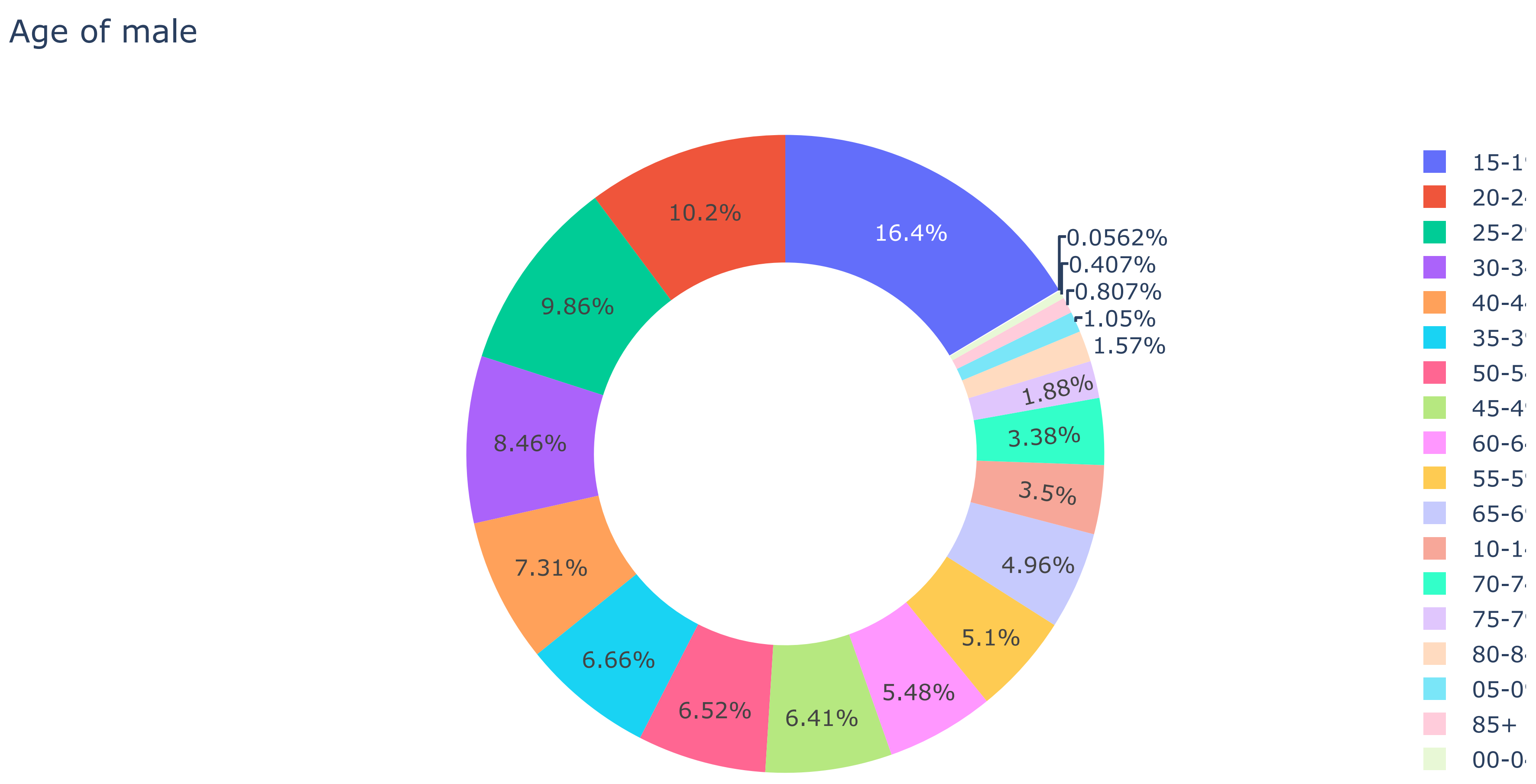
In [69]:
```
df = df_main[df_main['accident_region'] != 5] # Tel Aviv
df = df[df['sex'] == 1] # Males
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In Tel Aviv for Males"})

df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df = df.sort_values(by=['accident_hour']).reset_index(drop=True)

fig, ax = plt.subplots(figsize = (15,10))
fig = sns.lineplot(x='accident_hour', y='Total Accidents Per Hour In Tel Aviv for Males', data=df, ax=ax
fig = sns.barplot(x="accident_hour", y="Total Accidents Per Hour In Tel Aviv for Males", data = df,
                  ax=ax, palette="Blues_d")
x_dates = df['accident_hour'].sort_values().unique()
ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

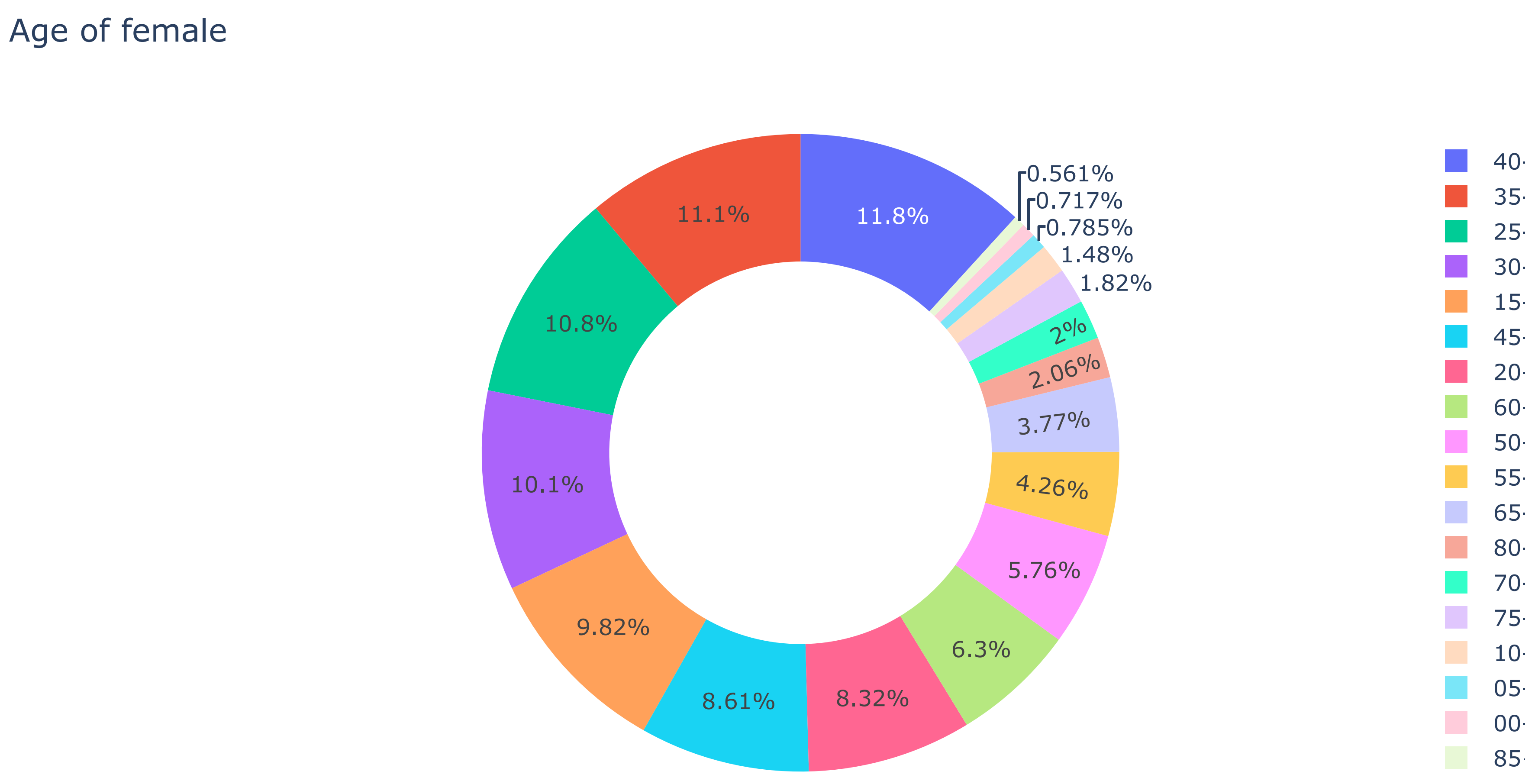
Out[69]:
```
[Text(0, 0, '0'),
 Text(1, 0, '1'),
 Text(2, 0, '2'),
 Text(3, 0, '3'),
 Text(4, 0, '4'),
 Text(5, 0, '5'),
 Text(6, 0, '6'),
 Text(7, 0, '7'),
 Text(8, 0, '8'),
 Text(9, 0, '9'),
 Text(10, 0, '10'),
 Text(11, 0, '11'),
 Text(12, 0, '12'),
 Text(13, 0, '13'),
 Text(14, 0, '14'),
 Text(15, 0, '15'),
 Text(16, 0, '16'),
 Text(17, 0, '17'),
 Text(18, 0, '18'),
 Text(19, 0, '19'),
 Text(20, 0, '20'),
 Text(21, 0, '21'),
 Text(22, 0, '22'),
 Text(23, 0, '23')]
```



Age

```
In [14]: # age by gender
         df = df_main[df_main['accident_region'] != 5] # Tel Aviv

         # we take only accidents with full gender data
         indecies = df['sex_hebrew'].isna()
         p_and_id = df[indecies]['provider_and_id'].to_numpy()
         df_gender = df[df['provider_and_id'].map(lambda x: x not in p_and_id)]

         df1 = df_gender[df_gender['sex'] == 1] # male
         Title = "Age of male"
         PlotPiechart(df1['age_group_hebrew'].values, df1, 'Age')

         df2 = df_gender[df_gender['sex'] == 2] # female
         Title = "Age of female"
         PlotPiechart(df2['age_group_hebrew'].values, df2, 'Age')
```



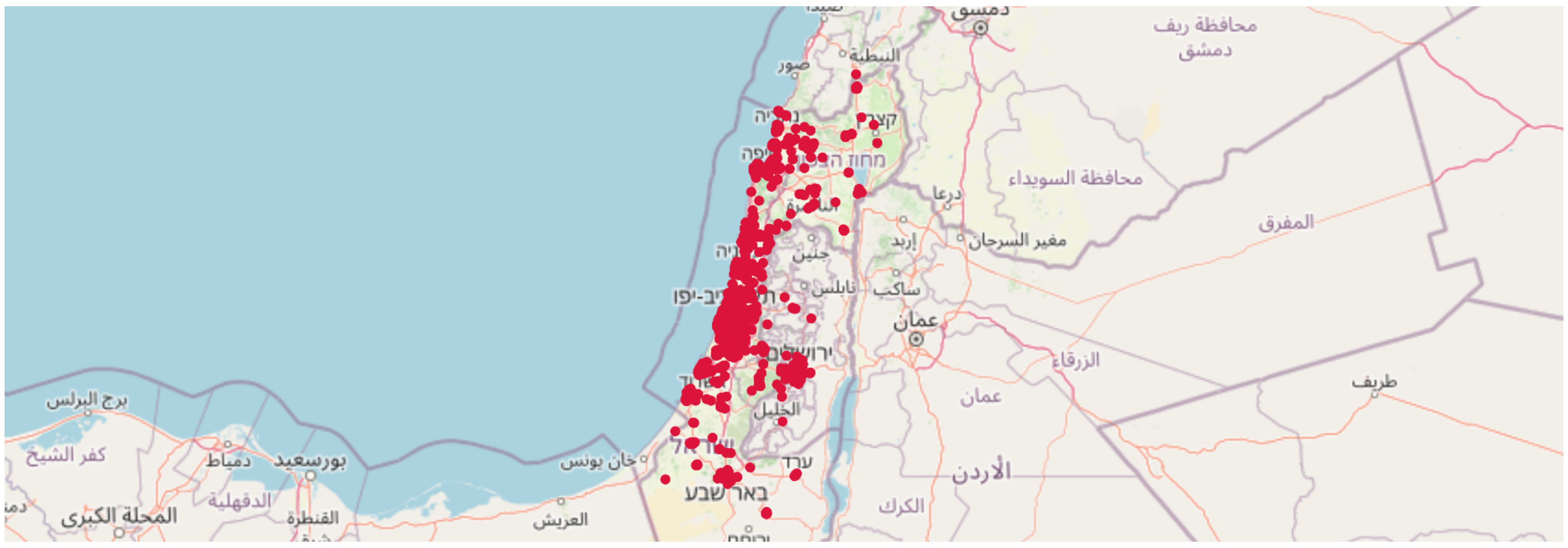


In [71]:
```
# age by gender
df = df_main[df_main['accident_region'] != 5]

# we take only accidents with full gender data
indecies = df['sex_hebrew'].isna()
p_and_id = df[indecies]['provider_and_id'].to_numpy()
df_gender = df[df['provider_and_id'].map(lambda x: x not in p_and_id)]

df1 = df_gender[df_gender['sex'] == 1] # male
df_male_age = df1['age_group'].values

# age by gender
df = df_main[df_main['accident_region'] != 5]

# we take only accidents with full gender data
indecies = df['sex_hebrew'].isna()
p_and_id = df[indecies]['provider_and_id'].to_numpy()
df_gender = df[df['provider_and_id'].map(lambda x: x not in p_and_id)]

df1 = df_gender[df_gender['sex'] == 2] # female
df_female_age = df1['age_group'].values

from scipy.stats import ttest_ind

male_mean = np.mean(df_male_age)
female_mean = np.mean(df_female_age)
print("male mean value:",male_mean)
print("female mean value:",female_mean)
male_std = np.std(df_male_age)
female_std = np.std(df_female_age)
print("man std value:",male_std)
print("female std value:",female_std)
ttest,pval = ttest_ind(df_male_age,df_female_age)
print("p-value",pval)
if pval <0.05:
  print("we reject null hypothesis")
else:
  print("we accept null hypothesis")
```

```
male mean value: 8.250557289344627
female mean value: 8.6071964017991
man std value: 4.33686243132963
female std value: 3.5595355089375564
p-value 0.05273950567245875
we accept null hypothesis
```

Map

In [15]:
```
import plotly.express as px
df = df_main
fig = px.scatter_mapbox(df, lat="latitude", lon="longitude", hover_name="accident_yishuv_name", hover_da
                        color_discrete_sequence=["crimson"], zoom=3, height=300)
fig.update_layout(mapbox_style="open-street-map")
fig.update_layout(margin={"r":0,"t":0,"l":0,"b":0})
fig.show()
```



Year Comparison

Total count of accidents

In [16]:
```python
f = df_main
df = df[df['Year'] == 2018]
df = df[['provider_and_id']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1})
print("Total count of accidents in 2018 = {}".format(len(df.index)))
df = df_main
df = df[df['Year'] == 2019]
df = df[['provider_and_id']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1})
print("Total count of accidents in 2019 = {}".format(len(df.index)))
```

```
Total count of accidents in 2018 = 2029
Total count of accidents in 2019 = 1829
```

Pedestrians injured

In [76]:
```python
df = df_main
df = df[df['Year'] == 2018]
df = df[df['injured_type'] == 1]
print("number of pedestrians injured in 2018 = {}".format(len(df.index)))
df = df_main
df = df[df['Year'] == 2019]
df = df[df['injured_type'] == 1]
print("number of pedestrians injured in 2019 = {}".format(len(df.index)))
```

```
number of pedestrians injured in 2018 = 215
number of pedestrians injured in 2019 = 193
```

Year 2019 there are less accidents than year 2018 !

Accidents count over time(Hourly) For 2018/19 separately

```
In [77]: df = df_main
df = df[df['Year'] == 2018]
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df = df.sort_values(by=['accident_hour']).reset_index(drop=True)

# 0 for day, 1 for night
df['Time'] = (df['accident_hour']>=20) | (df['accident_hour']<=5)
df = df.groupby(df['Time']).aggregate({'accident_hour':'first','Total Accidents Per Hour':'sum'})
df = df.rename(columns={"Total Accidents Per Hour":"Total Accidents per Part of the day"})
df = df.reset_index()

df['%'] = df['Total Accidents per Part of the day']/df['Total Accidents per Part of the day'].sum() *100

print("For 2018:")
print(df)

df = df_main
df = df[df['Year'] == 2019]
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df = df.sort_values(by=['accident_hour']).reset_index(drop=True)

# 0 for day, 1 for night
df['Time'] = (df['accident_hour']>=20) | (df['accident_hour']<=5)
df = df.groupby(df['Time']).aggregate({'accident_hour':'first','Total Accidents Per Hour':'sum'})
df = df.rename(columns={"Total Accidents Per Hour":"Total Accidents per Part of the day"})
df = df.reset_index()

df['%'] = df['Total Accidents per Part of the day']/df['Total Accidents per Part of the day'].sum() *100

print("For 2019:")
print(df)
```

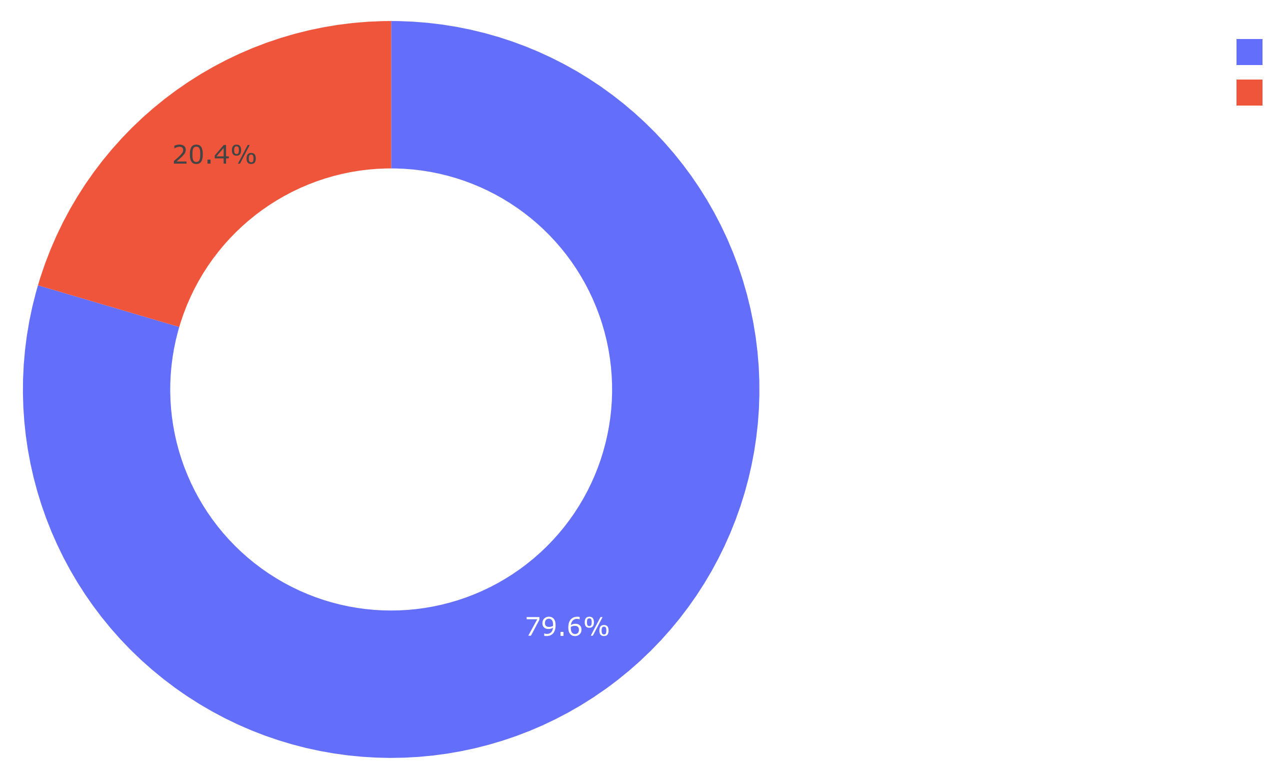
```
For 2018:
    Time  accident_hour  Total Accidents per Part of the day          %
0  False              6                                 1647  81.172992
1   True              0                                  382  18.827008
For 2019:
    Time  accident_hour  Total Accidents per Part of the day          %
0  False              6                                 1507  82.394751
1   True              0                                  322  17.605249
```

Junction

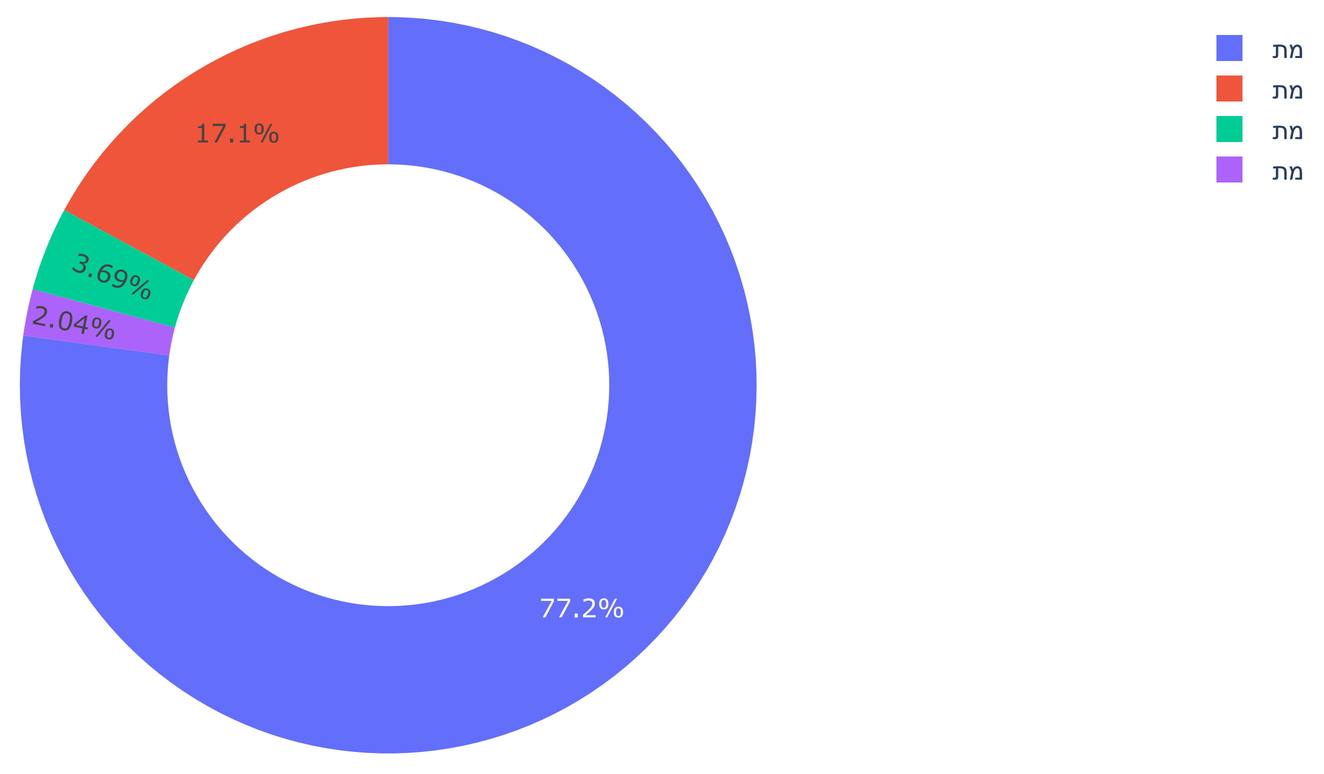
Number of accidents in a Junction (And in Tel Aviv vs Outside)

```
In [17]: df = df_main[df_main['accident_region'] == 5] # Tel Aviv

         Title = "Percentage of Accident happened In a Junction In Tel Aviv"
         PlotPiechart(df['road_type_hebrew'].values, df, 'Junction')

         df = df_main[df_main['accident_region'] != 5] # Outside

         Title = "Percentage of Accident happened In a Junction Outside Tel Aviv"
         PlotPiechart(df['road_type_hebrew'].values, df, 'Junction')
```

Percentage of Accident happened In a Junction In Tel Aviv



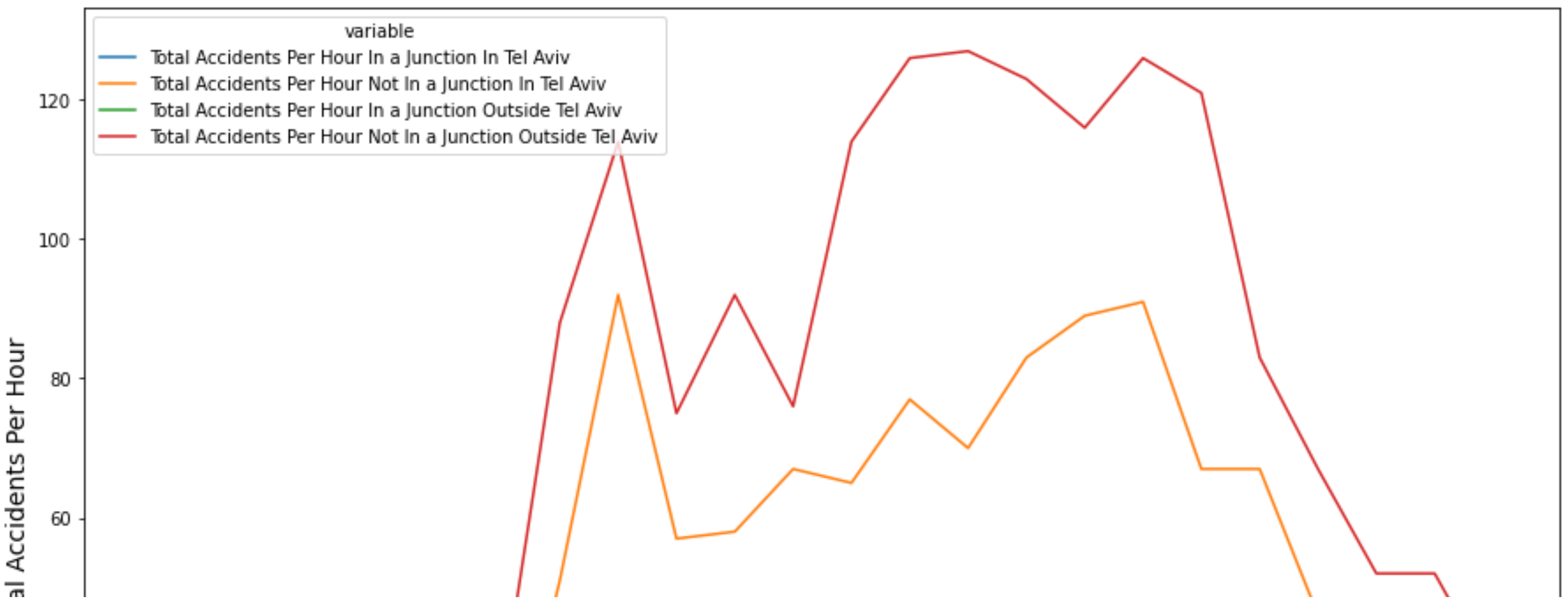
Percentage of Accident happened In a Junction Outside Tel Aviv

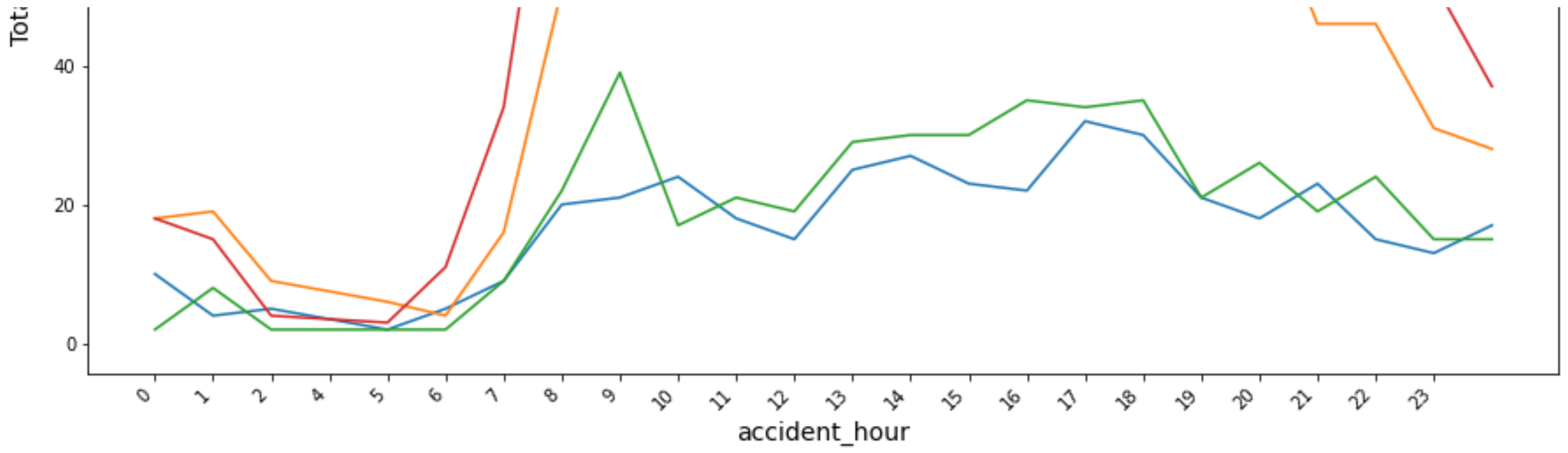


```
In [81]: # Graph of number of accidents vs time. with line of junction vs not junction. and tel aviv vs outside.

         df = df_main[df_main['accident_region'] == 5] # Tel Aviv
         df = df[df['road_type'] == 1] # Junction, Urban
         df = df[['provider_and_id','accident_hour']]
         df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
         df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In a Junction In Tel Aviv"})
         df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
         df_junction_tel_aviv = df.sort_values(by=['accident_hour']).reset_index(drop=True)
```

```
df = df_main[df_main['accident_region'] == 5] # Tel Aviv
df = df[df['road_type'] == 2] # Not Junction, Urban
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour Not In a Junction In Tel Aviv"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_not_junction_tel_aviv = df.sort_values(by=['accident_hour']).reset_index(drop=True)

df = df_main[df_main['accident_region'] != 5] # Outside Tel Aviv
df = df[df['road_type'] == 1] # Junction, Urban
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In a Junction Outside Tel Aviv"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_junction_outside = df.sort_values(by=['accident_hour']).reset_index(drop=True)

df = df_main[df_main['accident_region'] != 5] # Outside Tel Aviv
df = df[df['road_type'] == 2] # Not Junction, Urban
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'}
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour Not In a Junction Outside Tel Aviv"}
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_not_junction_outside = df.sort_values(by=['accident_hour']).reset_index(drop=True)

dfs = [df_junction_tel_aviv, df_not_junction_tel_aviv, df_junction_outside, df_not_junction_outside]

from functools import reduce
df_all = reduce(lambda left,right: pd.merge(left,right,on='accident_hour'), dfs)

# with pd.option_context('display.max_rows', None, 'display.max_columns', None):  # more options can be
#     print(pd.melt(df_all, ['accident_hour']))

fig, ax = plt.subplots(figsize = (15,10))
fig = sns.lineplot(x='accident_hour', y='Total Accidents Per Hour', hue='variable', ax=ax,
             data=pd.melt(df_all, ['accident_hour'], value_name='Total Accidents Per Hour'))
x_dates = df_all['accident_hour'].sort_values().unique()
ax.set_xticks(np.arange(len(x_dates)))
ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

```
Out[81]: [Text(0, 0, '0'),
          Text(1, 0, '1'),
          Text(2, 0, '2'),
          Text(3, 0, '4'),
          Text(4, 0, '5'),
          Text(5, 0, '6'),
          Text(6, 0, '7'),
          Text(7, 0, '8'),
          Text(8, 0, '9'),
          Text(9, 0, '10'),
          Text(10, 0, '11'),
          Text(11, 0, '12'),
          Text(12, 0, '13'),
          Text(13, 0, '14'),
          Text(14, 0, '15'),
          Text(15, 0, '16'),
          Text(16, 0, '17'),
          Text(17, 0, '18'),
          Text(18, 0, '19'),
          Text(19, 0, '20'),
          Text(20, 0, '21'),
          Text(21, 0, '22'),
          Text(22, 0, '23')]
```





Total number of accident in junction < Total number of accident in a not in junction

6 - 9 am accidents rises exponentially !

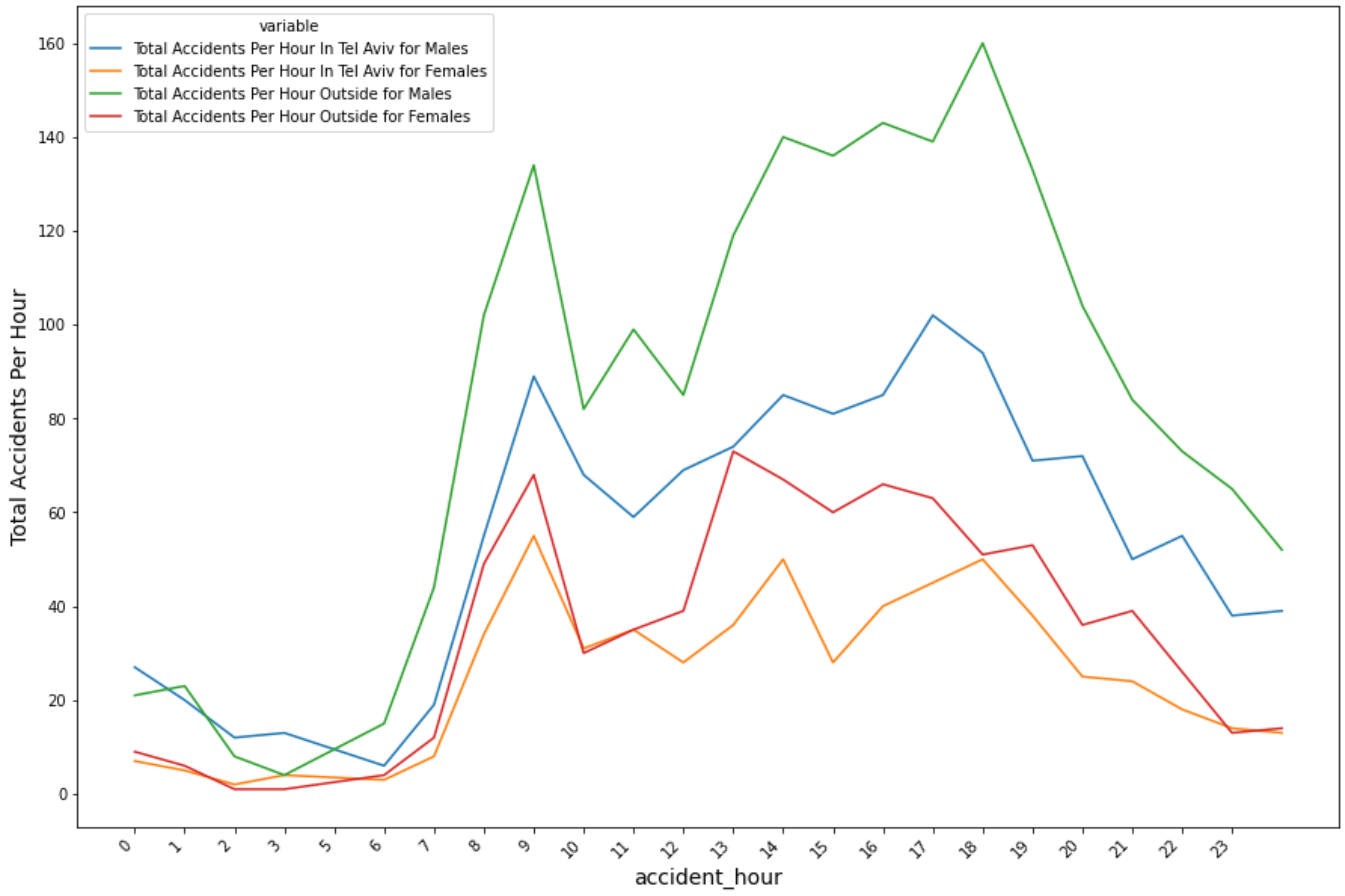
3-7 pm there are high number of accident

Gender Comparison

Accidents count over time(Hourly) for Males and Females (And in Tel Aviv vs Outside)

In [82]:
```
df = df_main[df_main['accident_region'] == 5] # Tel Aviv
df = df[df['sex'] == 1] # males
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'})
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In Tel Aviv for Males"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_male_tel_aviv = df.sort_values(by=['accident_hour']).reset_index(drop=True)

df = df_main[df_main['accident_region'] == 5] # Tel Aviv
df = df[df['sex'] == 2] # Females
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'})
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour In Tel Aviv for Females"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_female_tel_aviv = df.sort_values(by=['accident_hour']).reset_index(drop=True)

df = df_main[df_main['accident_region'] != 5] # Outside Tel Aviv
df = df[df['sex'] == 1] # males
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'})
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour Outside for Males"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_male_outside = df.sort_values(by=['accident_hour']).reset_index(drop=True)

df = df_main[df_main['accident_region'] != 5] # Outside Tel Aviv
df = df[df['sex'] == 2] # Females
df = df[['provider_and_id','accident_hour']]
df = df.groupby(df['provider_and_id']).aggregate({'provider_and_id':lambda x: 1,'accident_hour':'first'})
df = df.rename(columns={"provider_and_id":"Total Accidents Per Hour Outside for Females"})
df = df.set_index(['accident_hour']).sum(level=[0]).reset_index()
df_female_outside = df.sort_values(by=['accident_hour']).reset_index(drop=True)

dfs = [df_male_tel_aviv, df_female_tel_aviv, df_male_outside, df_female_outside]

from functools import reduce
df_all = reduce(lambda left,right: pd.merge(left,right,on='accident_hour'), dfs)

# with pd.option_context('display.max_rows', None, 'display.max_columns', None):  # more options can be s
#     print(pd.melt(df_all, ['accident_hour']))

fig, ax = plt.subplots(figsize = (15,10))
fig = sns.lineplot(x='accident_hour', y='Total Accidents Per Hour', hue='variable', ax=ax,
             data=pd.melt(df_all, ['accident_hour'], value_name='Total Accidents Per Hour'))
x_dates = df_all['accident_hour'].sort_values().unique()
ax.set_xticks(np.arange(len(x_dates)))
ax.set_xticklabels(labels=x_dates, rotation=45, ha='right')
```

Out[82]:
```
[Text(0, 0, '0'),
 Text(1, 0, '1'),
 Text(2, 0, '2'),
 Text(3, 0, '3'),
 Text(4, 0, '5'),
 Text(5, 0, '6'),
 Text(6, 0, '7'),
 Text(7, 0, '8'),
 Text(8, 0, '9'),
 Text(9, 0, '10'),
 Text(10, 0, '11'),
 Text(11, 0, '12'),
 Text(12, 0, '13'),
 Text(13, 0, '14'),
 Text(14, 0, '15'),
 Text(15, 0, '16'),
 Text(16, 0, '17'),
 Text(17, 0, '18'),
 Text(18, 0, '19'),
 Text(19, 0, '20'),
 Text(20, 0, '21'),
 Text(21, 0, '22'),
 Text(22, 0, '23')]
```

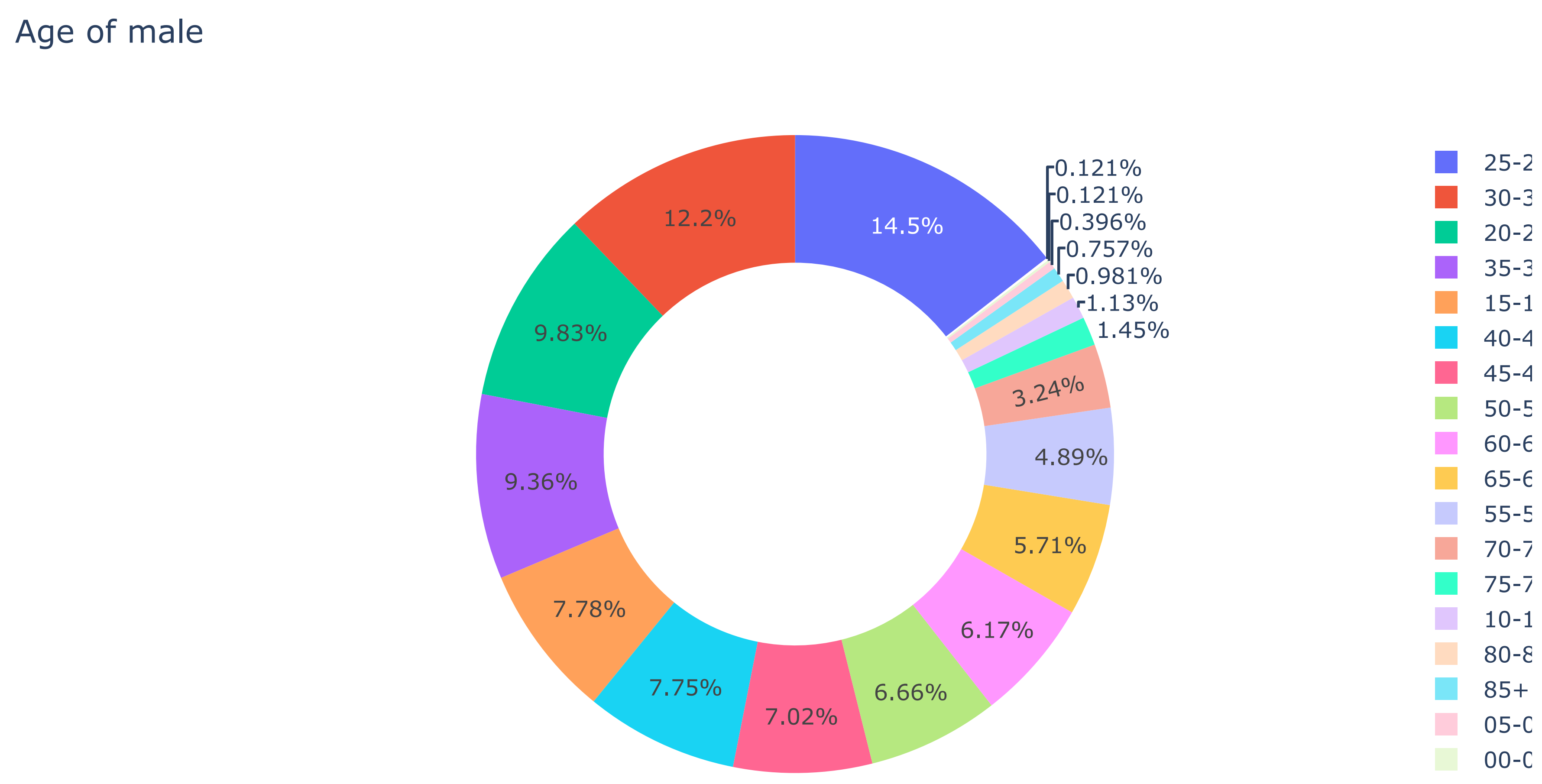


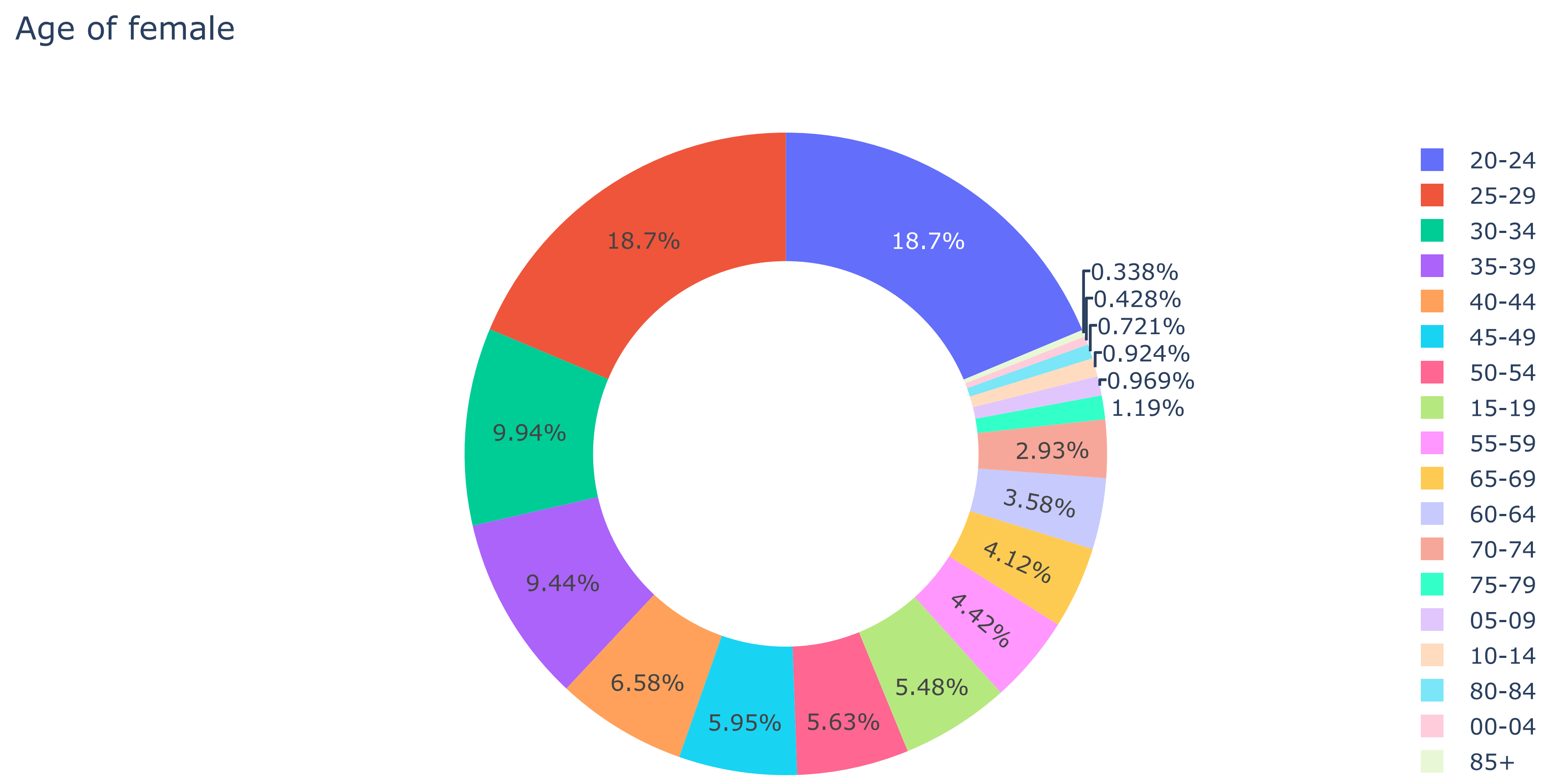
Males are more involved in accidents !

Females outside Tel Aviv are more involved in accidents than the females in Tel Aviv ! Same cases for males too !

Age

```
In [18]: df_tel_aviv = df_main[df_main['accident_region'] == 5] # Tel Aviv
         df = df_tel_aviv[df_tel_aviv['sex'] == 1] # male
         Title = "Age of male"
         PlotPiechart(df['age_group_hebrew'].values, df, 'Age')
         df = df_tel_aviv[df_tel_aviv['sex'] == 2] # female
         Title = "Age of female"
         PlotPiechart(df['age_group_hebrew'].values, df, 'Age')
```

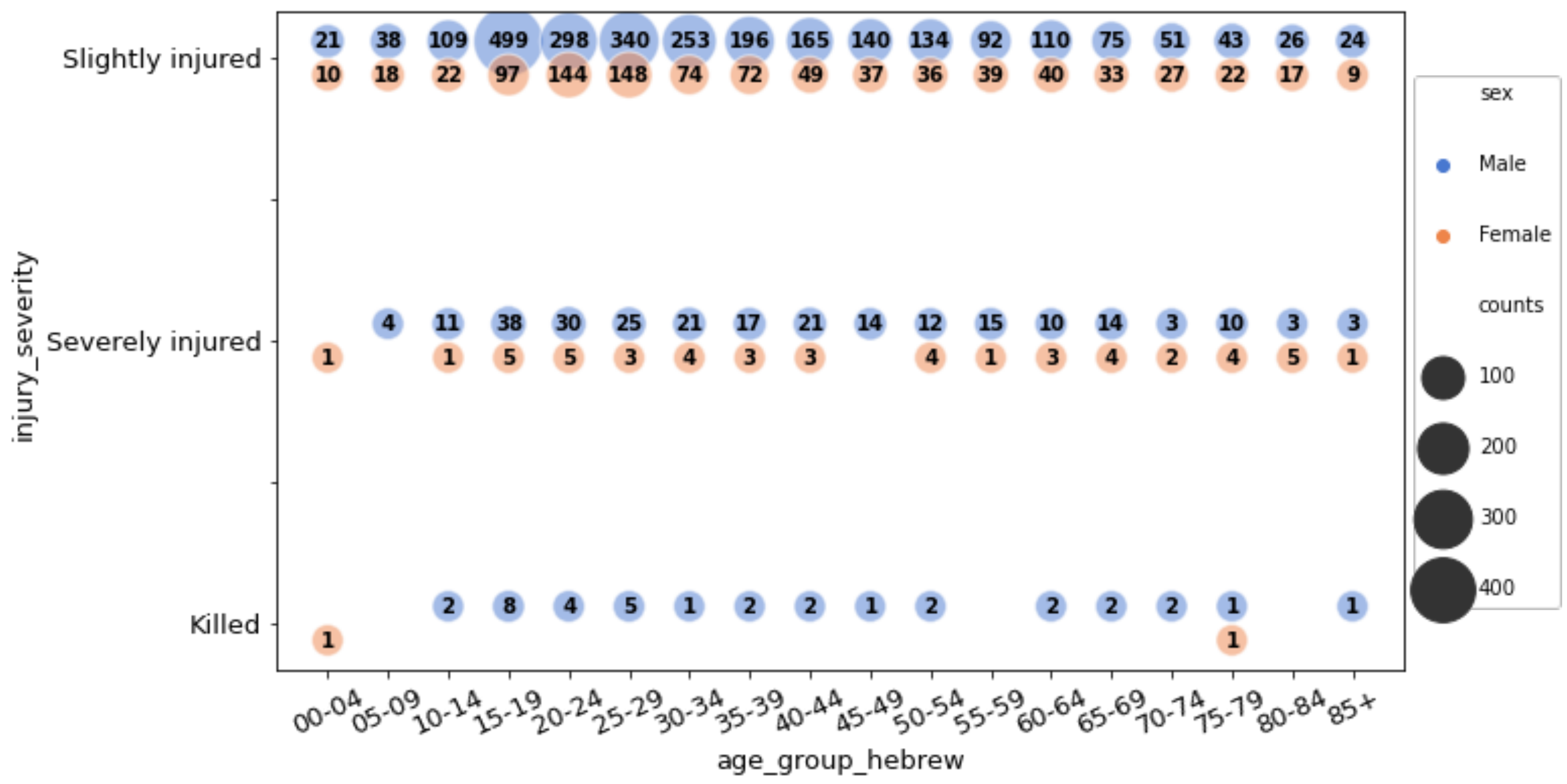




Accident severity for age and gender

Age, severity and gender

```
In [84]:  = df_main[['age_group_hebrew', 'sex', 'injury_severity']]
           = df[df['injury_severity']!=0]
           = df[df['age_group_hebrew']!='לא ידוע']
           = df.dropna().reset_index(drop=True)
           = df.groupby(df.columns.tolist()).size().reset_index().rename(columns={0:'counts'})

          ['injury_severity'] = np.where(df['sex']==1.0, df['injury_severity']+0.06, df['injury_severity'])
          ['injury_severity'] = np.where(df['sex']==2.0, df['injury_severity']-0.06, df['injury_severity'])

          ['sex'] = np.where(df['sex']==1.0, 'Male', 'Female')

          g, ax = plt.subplots(figsize = (10,6))
          g = sns.scatterplot(x="age_group_hebrew", y="injury_severity", hue="sex", size="counts",
                    sizes=(250, 1200), alpha=.5, palette="muted",
                    data=df, ax=ax)
          r tick in ax.get_xticklabels():
            tick.set_rotation(25)
          g.legend(loc='center left', bbox_to_anchor=(1.0, 0.5), ncol=1, labelspacing=2.5)
          r line in df.index:
            ax.text(df.age_group_hebrew[line], df.injury_severity[line], df.counts[line], ha='center', va='center',
                    color='black', weight='semibold')

          bels = [item.get_text() for item in ax.get_yticklabels()]
          bels[5] = 'Slightly injured'
          bels[3] = 'Severely injured'
          bels[1] = 'Killed'
          .set_yticklabels(labels)

          r item in ([ax.title, ax.xaxis.label, ax.yaxis.label] +
                     ax.get_xticklabels() + ax.get_yticklabels()):
            item.set_fontsize(13)
```

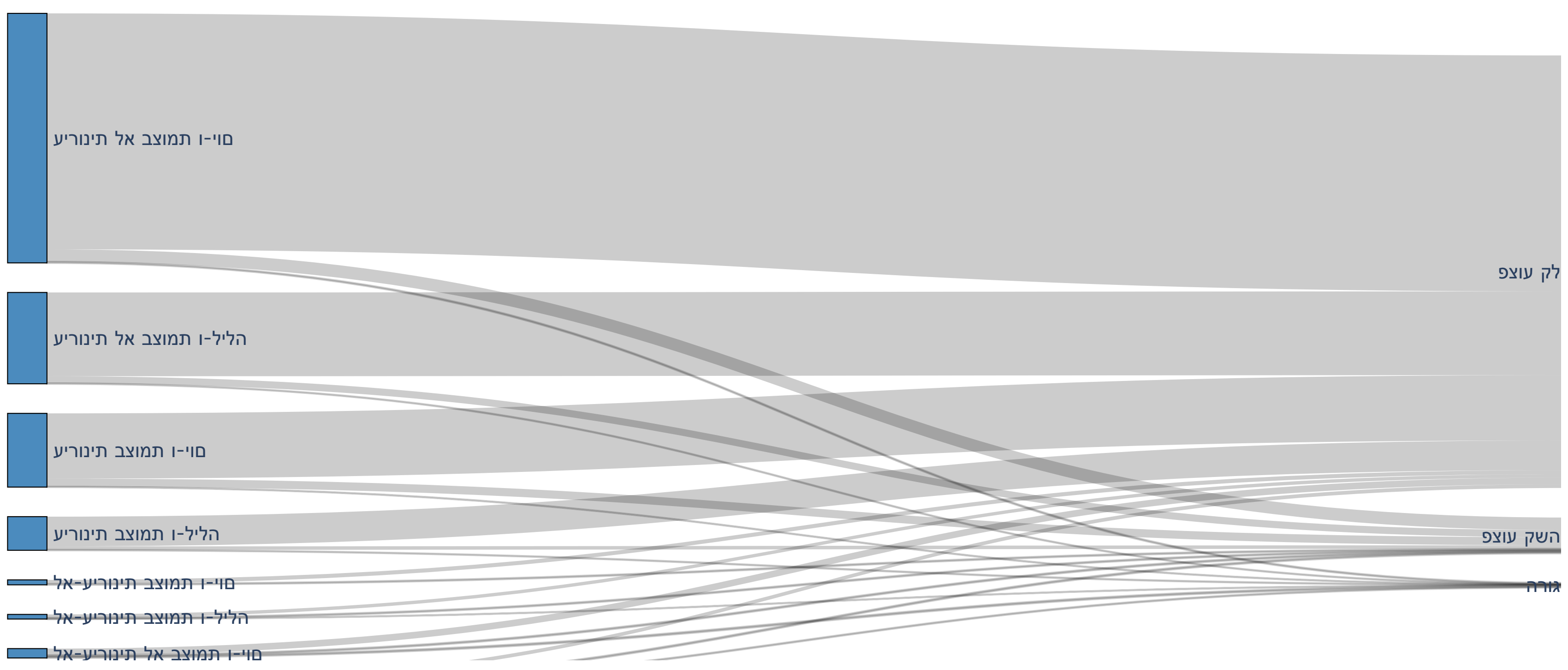


```
In [ ]:  ## Road Type and Day/Night to Injury Severity Sneaky Diagram
```

```
In [19]: ps://medium.com/kenlok/how-to-create-sankey-diagrams-from-dataframes-in-python-e221c1b4d6b0

         enSankey(df,cat_cols=[],value_cols='',title='Sankey Diagram'):
         maximum of 6 value cols -> 6 colors
         olorPalette = ['#4B8BBE','#306998','#FFE873','#FFD43B','#646464']
         abelList = []
         olorNumList = []
         or catCol in cat_cols:
             labelListTemp =  list(set(df[catCol].values))
             colorNumList.append(len(labelListTemp))
             labelList = labelList + labelListTemp

         remove duplicates from labelList
         abelList = list(dict.fromkeys(labelList))

         define colors based on number of levels
         olorList = []
         or idx, colorNum in enumerate(colorNumList):
             colorList = colorList + [colorPalette[idx]]*colorNum

         transform df into a source-target pair
         or i in range(len(cat_cols)-1):
             if i==0:
                 sourceTargetDf = df[[cat_cols[i],cat_cols[i+1],value_cols]]
```

```
        sourceTargetDf.columns = ['source','target','count']
    else:
        tempDf = df[[cat_cols[i],cat_cols[i+1],value_cols]]
        tempDf.columns = ['source','target','count']
        sourceTargetDf = pd.concat([sourceTargetDf,tempDf])
    sourceTargetDf = sourceTargetDf.groupby(['source','target']).agg({'count':'sum'}).reset_index()

: add index for source-target pair
ourceTargetDf['sourceID'] = sourceTargetDf['source'].apply(lambda x: labelList.index(x))
ourceTargetDf['targetID'] = sourceTargetDf['target'].apply(lambda x: labelList.index(x))

: creating the sankey diagram
lata = dict(
    type='sankey',
    node = dict(
      pad = 15,
      thickness = 20,
      line = dict(
        color = "black",
        width = 0.5
      ),
      label = labelList,
      color = colorList
    ),
    link = dict(
      source = sourceTargetDf['sourceID'],
      target = sourceTargetDf['targetID'],
      value = sourceTargetDf['count']
    )
  )

.ayout =  dict(
    title = title,
    font = dict(
      size = 10
    )


ig = dict(data=[data], layout=layout)
eturn fig


 df_main
 df[['road_type_hebrew', 'day_night_hebrew','injury_severity_hebrew']]
 df.dropna()
= ['road_type_hebrew', 'day_night_hebrew']
.vl1'] = df[cols].apply(lambda row: ' ו-'.join(row.values.astype(str)), axis=1)
.vl2'] = df['injury_severity_hebrew']
ount'] = 1

 df[['lvl1','lvl2','count']]

.vl1']= df.loc[:,'lvl1'].apply(lambda x: x[::-1])
.vl2']= df.loc[:,'lvl2'].apply(lambda x: x[::-1])

: genSankey(df,cat_cols=['lvl1','lvl2'],value_cols='count',title='Road Type and Day/Night to Injury Sever
 iplot(fig)
```

Road Type and Day/Night to Injury Severity Sneaky Diagram



Sankey diagram

Sankey diagrams are a type of flow diagram in which the width of the arrows is proportional to the flow rate.