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Clinical Medical Insights: Endocrinology and Diabetes

Lessons learned from COVID-19 Lockdown: An ASPED/MENA Study on Lifestyle Changes and Quality of Life during Ramadan Fasting in Children and Adolescents living with Type 1 Diabetes

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Keywords:	COVID-19, Lifestyle, Lockdown, Quality of life, Ramadan Fasting, Type 1 diabetes
Abstract:	<p>Background Lockdown was a unique experience that affected many aspects of life, particularly during the challenge of Ramadan fasting (RF). Studying this can increase understanding of the effects of lifestyle changes on quality of life (QoL) for children with type 1 diabetes (T1D) during RF.</p> <p>Methods A cross-sectional study that assessed the effect of lockdown on lifestyle</p>

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	<p>and QoL on fasting children living with T1D during Ramadan in the Middle East and North Africa region (2020-2021). We compared the child (self) and parent (proxy) reports using PEDQoL v3.0 disease specific questionnaire during lockdown and non-lockdown periods, and assessed correlations with lifestyle changes using regression and gap analyses.</p> <p>Results</p> <p>A total of 998 reports from 499 children with T1D aged 8-18 years (study=276, control=223), and their parents during RF in lockdown and non-lockdown periods. Fathers were more involved in their children's care during lockdown (p=0.019). Patients had better compliance with treatment (p= 0.002), a reversed sleep pattern (p= 0.033), increased food intake (p=<0.001) and less exercise (p<0.001). Children and parents perceived better QoL during lockdown (p=<0.001) with no differences between their reports in "Diabetes Symptoms", "Treatment Adherence" and "Communication" domains. Self and proxy reports were different in all domains during non-lockdown (p-values <0.001- 0.009). In gap analysis, although not statistically significant, the gap was approximated between children's and parents' perceptions in all domains during lockdown.</p> <p>Conclusion</p> <p>COVID-19 lockdown had a positive impact on QoL of children living with T1D during RF, possibly due to lifestyle changes and superior psychosocial family dynamics.</p> <p>Keywords: COVID-19, Lifestyle, Lockdown, Quality of life, Ramadan Fasting, Type 1 diabetes.</p>



Lessons learned from COVID-19 Lockdown: An ASPED/MENA Study on Lifestyle Changes and Quality of Life during Ramadan Fasting in Children and Adolescents living with Type 1 Diabetes

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Running title: COVID -19 lockdown and Quality of life in children with type 1 diabetes.

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3 Health-related quality of life (HRQoL) represents an essential outcome measure of health in
4 pediatric practice [1]. Improving quality of life (QoL) in chronic diseases has become an
5 important subject for researchers in the recent decades [2]. There is a clear relationship between
6 chronic diseases and reduction of QoL. Pediatric QoL disease specific questionnaires are
7 increasingly used to identify children at-risk and applying early appropriate interventions [3].
8 Type 1 diabetes mellitus (T1D) is a known disease that negatively affect QoL and is related to
9 multiple factors including severity of hypoglycemia, presence of complications, efficacy of
10 self-management of diabetes, and acceptance of the disease [4]. No doubt, understanding and
11 organizing care of children with type 1 diabetes reflect well on these children and their parents'
12 QoL [4] [5]. The fasting month of Ramadan especially during COVID-19 was a good
13 opportunity to revise the management of adolescents with type 1 diabetes, with a positive
14 involvement of different family members in the child's management.
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26 Ramadan fasting (RF) has always posed a particular challenge, affecting QoL, in patients with
27 T1D. Challenges include maintaining glycemic control, and sometimes, fasting for the first
28 time in adolescents [6]. There are multiple shifts in lifestyle that occur during Ramadan
29 including changes to mealtimes and sleep patterns. These have a direct effect on the body
30 physiology that leads to disturbance in several homeostatic and hormonal processes [7],[8]. For
31 example, shifting sleep timing during Ramadan will lead to changes in body temperature and
32 cortisol level that affect blood glucose levels [9]. Because of that, fasting Muslim children and
33 adolescents living with T1D are at risk of hypoglycemia, hyperglycemia, diabetic ketoacidosis,
34 dehydration and thrombosis during RF [10],[11].
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43 During the COVID-19 pandemic, lockdown was an international experience. A complete
44 lockdown was implemented as a preventative measure to stop the spread of the virus. This was
45 a unique experience which affected many aspects of life and subjected children in particular to
46 a new adjustment of their schooling system as well as changes to social interactions and care
47 received in children with chronic diseases [12]. Lockdown highlighted challenges experienced
48 by families of children living with long term illnesses, including psychosocial challenges as
49 well as difficulties with providing care to their young. Furthermore, lockdown resulted in
50 restrictions to physical activities with RF resulting in added changes to sleep pattern and dietary
51 intake. While lockdown resulted in many challenges for families it also held the potential for
52 improving psychosocial bonding between family members - and especially for children living
53 with T1D and their carers.
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3 The aim of this study was to assess the impact of lockdown on lifestyle, diabetes management
4 and QoL in fasting children living with T1DM during RF in different Muslim countries in the
5 Middle East and North Africa (MENA) regions.
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10 **Research design and methods**

11 ***Study design and tools***

12 This is a cross-sectional multicenter study, in which we compared the experience reported by
13 patients fasting Ramadan during the complete lockdown period in 2020 (study group) to
14 patients fasting Ramadan during non-lockdown (or partial lockdown, commonly in daytime
15 hours) in 2021 (control group). The study was designed by a research group of the Arab Society
16 of Pediatric Endocrinology (ASPED). Children living with T1D were enrolled from multiple
17 centers in the MENA region. Participating countries included: Saudi Arabia, Kuwait, Oman,
18 Bahrain, Sudan, Egypt, Palestine and Jordan.
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27 We assessed the *lifestyle changes* in Ramadan by asking questions about sleep pattern
28 changes, dietary habits, indoor and outdoor exercise activities including night time special
29 prayers in Ramadan (Tarawih prayer), hours spent on electronic devices and any major
30 differences in lifestyle during current lockdown compared to non-locked time. We also
31 assessed the effect of complete lockdown compared to non or partial lockdown on the
32 *perception of QoL* and any possible relationship with changes in lifestyle. We used a
33 validated Arabic version of a disease specific health related quality of life (HRQoL)
34 questionnaire (PEDQoL) version 3.0 designated for children living with diabetes and their
35 parents [13]. The questionnaire contained items clustered in five domains of QoL, these
36 were (1) diabetes symptoms (2) treatment barriers, (3) treatment adherence, (4) worry and
37 (5) communication. In addition, there were questions about demographics included age,
38 gender, duration of diabetes, type of treatment; (conventional, multiple daily injection
39 (MDI) therapy or continuous subcutaneous insulin infusion (CSII)), parents' level of
40 education, socioeconomic status, the primary caregiver who most typically delivers
41 injections and compliance with treatment.
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54 All families included in the study were approached by the research group by direct interview
55 either in-person (while visiting the outpatient department) or via telephone interview (during
56 the complete lockdown), where the questions were read out to children and the
57 accompanying parent after obtaining verbal consent to participate in the study.
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Study population

There were two groups of patients. The study group was recruited in 2020 and included participants from Saudi Arabia, Egypt, Oman, Bahrain and Kuwait who fasted Ramadan during the pandemic complete lockdown. The control group included participants from Egypt, Palestine, Jordan and Sudan was recruited in 2021 when the lockdown had been lifted, at least partially in the evening hours until dawn, in some countries.

Each center recruited between 50 – 60 patients for inclusion in either the study or control group (of note, Egypt recruited patients in both the study and control groups). Inclusion criteria were: Children and adolescents of 10-18 years of age living with T1D, patients diagnosed with T1D for more than 6 months, and observing fasting for at least 50% of the Ramadan month. Exclusion criteria included additional diagnoses with other autoimmune or chronic diseases, a recent diagnosis (<6 months) of diabetes, recent severe infections or a learning difficulty or developmental delay which could impair the completion of questionnaires. A contribution of 50-60 patients per centre from 8 MENA countries resulted in an estimated total sample size of 400 - 480 children living with T1D. Patients enrolled in the study and control groups were matched by age and gender.

Data analysis

Descriptive analysis described continuous data. Categorical variables were described using frequency and percentages. Mean and SD were used to describe parametric continuous variables and median (interquartile range for non-parametric continuous data). ANOVA tests were implemented for comparisons between self and proxy reports. For assessment of risk factors that might affect the QoL scores in children, spearman correlations and regression analyses were used. Paired t-test was used for comparisons within groups while independent t-test was used for comparison across groups. Multivariable regression analysis was used to compare quality of life scores across each lifestyle parameter individually. A p-value <0.05 was considered statistically significant.

Results

The sample consisted of a total of 998 self (child) and proxy (parent) reports from 499 children with T1D. Data was collected from a study group (N=276) and a control group (N=223). The study and control groups were matched for age, gender and parents' level of education (Table1).

Demographics (Table 1)

Children's ages ranged between 8 to 18 years. The majority of participants were females (study 53.3% vs control 50.7%). Accommodation type was included in the study. Open residential areas meant that children did not have any access to workout facility, whereas living in compounds gave some room to move around. The number of participants who live in open residential areas was comparable between study and control group, however, there were more patients living in compounds in the study group. There was a difference in the socioeconomic status between the groups, (P-value <0.001) as 25.9% of study group reported high socioeconomic status as compared 8.5% in the control group.

Insulin regimen

As for insulin regimen, 92.8% of the control group reported MDI use as compared to the study group (81.8%) (Table 1). Overall, children living with T1DM were more compliant with treatment during the lockdown period. Interestingly, greater adherence to insulin therapy was observed in the lockdown group (p-value 0.004). Dose of insulin is usually adjusted during Ramadan to accommodate the change in routine that occurs naturally with fasting and there was an increase in total daily dose of insulin in the lockdown group as compared to the control group (p<0.001). There was also greater involvement of family members in insulin dose delivery in the lockdown group as compared to the control group. Fathers' involvement was noted by assessing who was accompanying the child to their check-up or virtual follow up that was greater during lockdown (24.6%) as compared to non-lockdown (9.4%), (p<0.001). Also, fathers and other family members, but not their mothers, were the main care providers to these children in 33% during lockdown compared to 21% during non-lockdown period (P<0.019).

Lifestyle changes (Table 1)

There were significant differences in lifestyle parameters during Ramadan between the lockdown and the non-lockdown groups. They included in the lockdown group (as compared to the control group): worse reversed sleep pattern (p= 0.033) and an increased number of meals with lower carbohydrate consumption (p=<0.001). Better compliance with treatment was reported by the lockdown group (p=0.002) as 60.1% of those in the lockdown group reported good compliance during lockdown as opposed to 50.9% in the non-lockdown group. A greater proportion of children in the lockdown group reported a significant lack of exercise (56.7%) as compared to those in the non-lockdown group (43.5%). Even Taraweh prayers were performed less in the study group as compared to the control group (p=<0.001). There was an increase in hours spent using electronic devices in the lockdown group (6.1 hours +_ 3.6 SD) as compared to the non-lockdown group (3.9 hours +- 2.2 SD; p <0.001). The number of meals

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3 was greater in the lockdown vs the control group ($p < 0.001$). The challenge of fasting Ramadan
4 was considered to be lower in the lockdown group as compared to the control group (48.7% of
5 patients reported RF to be challenging in the lockdown group as compared to 85.2% of patients
6 during non-lockdown, $p < 0.001$).

7 8 9 **QoL: Self vs proxy reports (Table 2)**

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11 Children and parents in the lockdown group perceived an overall better QoL in all domains
12 compared to the control group ($p = < 0.001$). There was no difference between child and parent
13 perception of QoL during lockdown in “Diabetes Symptoms”, “Treatment Adherence” or
14 “Communication” domains. However, there was significant difference in their perception of
15 QoL in all other domains during non-lockdown and in the “Treatment barriers” and “Worries”
16 domains during lockdown (P values range from < 0.001 to 0.009).

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23 Despite the significant variations in variables of lifestyle in the study and control groups, none
24 of these variables had a significant individual effect when regressed against QoL scoring in
25 self and proxy reports.

26 27 28 29 **Lockdown Vs Non-lockdown (Table 2 and Figure 1)**

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32 Using regression analysis, and focusing on self-report data, we found that group status
33 (lockdown vs non-lockdown) predicted “Diabetes symptoms” and “Treatment adherence”
34 domains as well as in total aggregate scores (Table 3). The same was found for parent-report
35 data (Table 3). Group status predicted QoL (aggregate score and all domains' scores) in self
36 and proxy reports – with a better QoL reported for the lockdown group. For the “worry”
37 domain, and when focusing on parent-report, this effect was particularly pronounced in the
38 older age group (13-18 years) in both genders (Figure 1). The male older age group (13-18
39 years) scored much better in the “Treatment barriers” domain during lockdown compared to
40 other age group (Figure 1).

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49 Using gap analysis to compare the variations in self and proxy reports in different domains,
50 there was an approximation in the gap between children and parents' perceptions in all domains
51 during lockdown. However, that was not statistically significant (Figure 1).

Discussion

Risk of complications in children with T1D includes hypoglycemia and hyperglycemia. These complications are closely related to the changes that normally occurs in lifestyle during Ramadan including diet, exercise and insulin requirement. COVID-19 lockdown was an additional burden on families with children and adolescents living with T1D. Having T1D is a risk factor for adverse outcomes during the COVID-19 lockdown [14].

The study group had faced a combination of three challenges, having type 1 diabetes, fasting Ramadan as well as being subjected to lockdown. Hence, it could be postulated that additional changes during the lockdown to lifestyle could pose further risks that can affect the outcome of these patient's QoL.

The lockdown resulted in people staying at home and spending unprecedented amounts of time with their children. This global experience was novel and no similar periods have been studied to this extent. Undoubtedly, lockdown impacted the mental health on a societal level [15]. Children and adolescents are the most sensitive age groups to be affected by drastic changes in lifestyle [15]. Given that fasting Ramadan had always posed a challenge on children with T1D, we observed experiences while fasting during the month of Ramadan. Specifically, we compared lifestyle, QoL and diabetes management (including diet, exercise and insulin dosage) during RF in children and adolescents living with T1D who reported symptoms during complete lockdown period to those who reported symptoms during incomplete/partial lockdown (essentially referred to as non-lockdown) period.

Exercise

In general, outdoor activities improve the cognitive, physical, social, and emotional health of children [16]. Decreased physical activity is one of the lifestyle changes that has been observed during Ramadan among Muslim populations [17]. A recent paper have even discussed the fitness for work of an adult Muslim who fasts during Ramadan and adjustment of working hours to meet these needs [18]. There is a debate about the psychological effect of outdoor activities for type 1 DM patients, though it improves the general wellbeing and in some studies was proposed to have a therapeutic effect. The COVID-19 outbreak led to lockdown and limitations of this type of activities [19].

A central issue associated with spending prolonged hours a day at home is the lack of physical exercise which, was demonstrated in our control group. Lockdown, surprisingly did not affect

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3 exercise negatively. Although, it was thought that indoor activities **versus** outdoors would have
4 negatively impact children's QoL during lockdown time. Nevertheless, that was not the case
5 in our cohort. Despite that there were more participants living in enclosed residential areas in
6 the study group, there was no difference in outdoor activities reported between the groups. We
7 propose that lack of exercise is an issue regardless of restrictions imposed by the compulsory
8 lockdown. This is supported by the fact that subjects who lived in compounds, where there are
9 facilities to use during lockdown, did not have a significant improvement in exercise practices.

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12 Muslims perform prayers five times daily all year round and during Ramadan, additional
13 prayers take place (called Taraweeh). These differ from regular daily prayers by being longer
14 in duration and timed shortly after breaking the fast. Therefore, this activity is considered as
15 an exercise of moderate intensity. We included Taraweeh as part of exercise. The prayers are
16 usually preformed in groups at mosques. Understandably, therefor, Taraweeh were performed
17 less during the lockdown as compared to the control group in our cohort (<0.001).

28 29 ***Screen time***

30 Being confined to one space increased screen time. That in itself can contribute to
31 psychological issues [20]. Studies have shown an increase in level of anxiety and depression
32 with extended screen time and excessive use of internet and social media platforms [21]. As
33 expected, screen time had inevitably increased during lockdown. However, the increase in
34 hours spent on devices also included time spent studying from home which, theoretically, could
35 have resulted in less psychosocial consequences as compared to the leisure use of devices.

42 43 ***Positive family dynamics***

44 Some studies have found increased tension in households during lockdown due to the stress of
45 quarantine [22]. However, we found improvement in family dynamics in the lockdown group
46 as compared to the control group. This was evidenced by increased involvement in the care of
47 patients during the lockdown. Comparing our two groups, we noted more involvement of
48 fathers and other family members during the lockdown in the delivery of insulin injections.
49 Many factors could have contributed to this improvement. First, we propose that increased time
50 spent at home improved the communication and strengthened the ties between family
51 members. Communication with parents increased and parents were perhaps more attentive to
52 their children's needs. Close supervision of the management of T1D by parents, increased
53 family interactions and support from both parents and other members of the family to children
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3 living with T1D could have improved both children and parents' perception of QoL during this
4 new challenging experience of fasting of youngsters living with T1D.
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8 In our study, we noticed more father involvement in patient's care during the lockdown, as
9 opposed to solely mothers being the primary care-providers. This change is favorable and
10 would likely reduce the parenteral stress and burden of taking care of a child with a chronic
11 condition such as T1D [23]. The positive effect of family involvement has been highlighted in
12 the literature previously, and many studies have focused on improving health outcomes in
13 children and adolescents living with type 1 diabetes via using family based interventions [24].
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20 ***Effect on insulin***

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22 In our study, there was greater adherence to insulin therapy during the lockdown period and an
23 increase in total daily dose of insulin in the lockdown group. This was consistent with an Italian
24 study that found a significant increase in insulin boluses during COVID lockdown compared
25 to non-lockdown in pre-school and school aged children. They proposed that during lockdown,
26 more parental involvement led to that enhancement in metabolic effect [25].
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32 ***Effect on quality of life***

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34 Superior QoL during RF was reported during the pandemic lockdown as compared to the
35 control group. Improved dietary habits, better treatment compliance and adherence which, we
36 attributed to more involvement of family members in supporting children and adolescents
37 living with T1D through the stressful experience of RF. These changes that lockdown has
38 brought on lifestyle, besides improvement in family interactions and greater support for
39 children with T1D, have improved the QoL for these children and adolescents.
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46 Despite the significant variations in some variables of lifestyle between the two groups, when
47 QoL scores were regressed against these individual parameters, none of them had a significant
48 impact on the QoL scoring in both children and parents' reports. This indicates, that the
49 significant overall and individual domains effects had resulted from them collectively in
50 addition to the expected, but difficult to accurately measure, positive effects of family
51 dynamics and social interactions that improved communication, adherence to treatment and
52 reduced concerns about symptoms and acute and long-term complications.
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3 The overall and individual domains' QoL scores were consistently better during lockdown.
4 That was more apparent in the older age group (13-18 years) in both genders and more
5 specifically in the "Worry" domain in the proxy report. Probably parents felt that their children
6 were less worried during lockdown as there were no outdoor activities and fewer commitments
7 during fasting time in the lockdown. The male older age group (13-18 years) scored much
8 better in the "Treatment barriers" domain during lockdown compared to other age groups
9 probably with the help and support from other family members. This is the main group who
10 typically shows the risk-taking behavior of missing insulin doses [1]. Also, the younger age
11 (10-12 years) group is probably still well-attached to parents and follows their guidance and
12 instructions on management better than the older age (13-18 years) group.
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22 The lockdown imposed immense restrictions on social interactions. Schools closed down and
23 contact with classmates, friends and extended family varied in nature and was limited. That
24 might have been isolating and was associated with depression and increased loneliness [20].
25 However, some children and adolescents living with T1D struggle with shame around peers
26 with delivering injections [26]. That was no longer apparent in our study group and the worry
27 domain was reduced as compared to the control group. Being close to parents and other family
28 members during the lockdown period could have reduced the worries about potential
29 hypoglycemic episodes during fasting hours and at the time of unattended outdoor activities
30 that are popular among adolescents in Ramadan's night-time.
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40 Interestingly, there was a smaller gap between adolescents' and parents' perceptions of the
41 QoL in children with T1D, in the lockdown group as compared to the non-lockdown group
42 (although this difference was not statistically significant). One reason for this could be the
43 alignment of experiences between children and their parents during lockdown. The gap
44 between self-report and parent-report was greater in the older adolescent age group (13-18
45 years of age), as compared to the younger age-group. This could reflect different thinking styles
46 during adolescents as compared to other developmental stages [27]. The neuronal sensitivity
47 to motivational factors develops during adolescence, hence; teens compared to adults may
48 possess novelty-seeking and risk-taking behaviors [28],[29]. Moreover, adolescents do not
49 prefer to share their worries if that reflects a limitation in confidence or lacking experience
50 [30]. Their decision making could also be influenced by peers or other emotions and social
51 contexts [29],[31]. This distinct behavior may frequently result in disagreement with parents
52 in management of their diabetes [30]. Hence; a sustainable gap had remained between self and
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3 proxy reports of QoL in the two periods of our study, possibly due to different perspectives of
4 parents and these adolescents, especially the older age group.
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8 ***Study limitations***

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10 Our data reflected on a cohort from various MENA countries with multiple variations in
11 socioeconomic status, dietary habits and lockdown policies. Children and adolescents
12 included in the study had different socioeconomic backgrounds. Some had the privilege to live
13 in compounds where they had access to exercise facilities and experienced more freedom in
14 mobility during the lockdown. Participants had different insulin regimens based on their
15 income, with MDI mostly used with lower socioeconomic status. As we appreciate these
16 differences and the effect they might have had, there was no way to adjust for it. Despite being
17 from different groups of countries, most share similar cultures and rituals during Ramadan
18 Fasting. However, there are some minor variations in food and eating habits/traditions between
19 different countries in MENA region due to cultural differences, which was difficult to adjust
20 for in our study. Due to variations in the extended lockdown time policy, we were unable to
21 recruit the same patients during the non-lockdown/partial lockdown period.
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24 Another challenge we faced during data collection was that the number of children who fasted
25 for the first time was higher in the control group, hence; an increase in the percentage of
26 incomplete RF (50%) in that group. It was also difficult to conclude whether the incomplete
27 RF was because of facing more challenges or due to a decreased enthusiasm related to a belief
28 of not reaching the appropriate age to complete RF. Although the patients were well matched
29 in the two groups and changes in lifestyle between the groups were adjusted for, there could
30 be some hidden unmeasured additional psychosocial factors related to parents/adolescents'
31 relationship in the two groups.
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48 **Conclusion**

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50 COVID-19 lockdowns resulted in great risks for children and adolescents. However, the
51 change in lifestyle experienced also provided great opportunities. By comparing patient groups
52 recruited during and after the lockdown, we found that the lockdown group reported superior
53 family dynamics, which were associated with a superior QoL in fasting Muslim children and
54 adolescents living with T1D. Clinical implications of this work include that diabetes treating
55 teams could emphasize these lifestyle changes and family psychosocial interactions through
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3 family-targeted programs to support the successful management and positively enhance QoL
4 in children and adolescents with T1D during the potentially stressful experience of RF. This
5 holds true regardless of the challenges of COVID and associated lockdowns.
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25 **Conflict of interest**

26 The authors declare no conflict of interest.

27 **Data Availability**

28 The datasets generated during and/or analyzed during the current study are available from the
29 corresponding author on reasonable request.
30
31

32 **Authors' contribution**

33 AB– Conceptualized the idea. AB and IA – Study designing. BA, AB – Writing the first draft,
34 NE, BA, KA, SY, DA, HA, HayA, RO, OB, AA, NA, AmA, FA, EM - Data collection and
35 drafting the manuscript. EM – Data analysis, EM, AB, BA – Data interpretation and writing
36 the results. AD, JW-B, AM.G, IA and MH – drafting, further interpretation of results and
37 editing the manuscript. All authors approved the final submitted manuscript.
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For Peer Review

		Lockdown		Non-lockdown		P-Value
		N	%	N	%	
<i>Age (years)</i>	8 - 12	93	33.7%	94	42.2%	0.052
	13 - 18	183	66.3%	129	57.8%	
<i>Gender</i>	Male	129	46.7%	110	49.3%	0.565
	Female	147	53.3%	113	50.7%	
<i>Parents' level of education</i>	Up to high school	109	40.5%	80	35.9%	0.292
	University	160	59.5%	143	64.1%	
<i>Accompanying parent</i>	Mother	182	65.9%	154	69.1%	<0.001
	Father	68	24.6%	21	9.4%	
	Both	26	9.4%	41	18.4%	
	Other	0	0.0%	7	3.1%	
<i>Main care-provider</i>	Child	69	26.4%	69	30.9%	0.019
	Mother	106	40.6%	107	48.0%	
	Father	14	5.4%	4	1.8%	
	Other	72	27.6%	43	19.3%	
<i>Total dose of insulin*</i>	Decreased	91	57.2%	126	57.5%	<0.001
	Same	34	21.4%	75	34.2%	
	Increased	34	21.4%	18	8.2%	
<i>Injection delivered by*</i>	Child	146	55.9%	110	49.3%	<0.001
	Mother	28	10.7%	80	35.9%	
	Father & Others	87	33.3%	33	14.8%	
<i>Adherence to treatment*</i>	Poor	40	14.9%	56	25.1%	0.004
	Average	74	27.6%	69	30.9%	
	Good	154	57.5%	98	43.9%	
<i>Is fasting Ramadan challenging?</i>	Yes	132	48.7%	173	85.2%	<0.001
	No	139	51.3%	30	14.8%	
<i>Sleep pattern</i>	Reverse sleep pattern	238	86.5%	177	79.4%	0.033
	Normal sleep pattern	37	13.5%	46	20.6%	
<i>Food contents and portion</i>	Increased portion = Carbs 90-100 g/meal	147	58.8%	147	66.5%	<0.001
	Same, Carbs 60-75 g/meal	64	25.6%	72	32.6%	
	Decreased portion, Carbs <60 g	39	15.6%	2	0.9%	

<i>Number and timing of meals</i>	(Mean, SD)	2.8 (0.4)		2.3 (0.8)		<0.001
<i>Hours spent on electronic devices</i>	(Mean, SD)	6.1 (3.6)		3.9 (2.2)		<0.001
<i>Exercise</i>	No	110	56.7%	97	43.5%	<0.001
	Tarawih Prayer (Mild intensity)	8	4.1%	44	19.7%	
	Medium intensity	35	18.0%	30	13.5%	
	High intensity	41	21.1%	52	23.3%	
<i>Compliance with treatment</i>	Poor	31	11.6%	53	23.9%	0.002
	Average	76	28.4%	56	25.2%	
	Good	161	60.1%	113	50.9%	
	Partial	1	0.4%	40	17.9%	

*Not reported by all patients

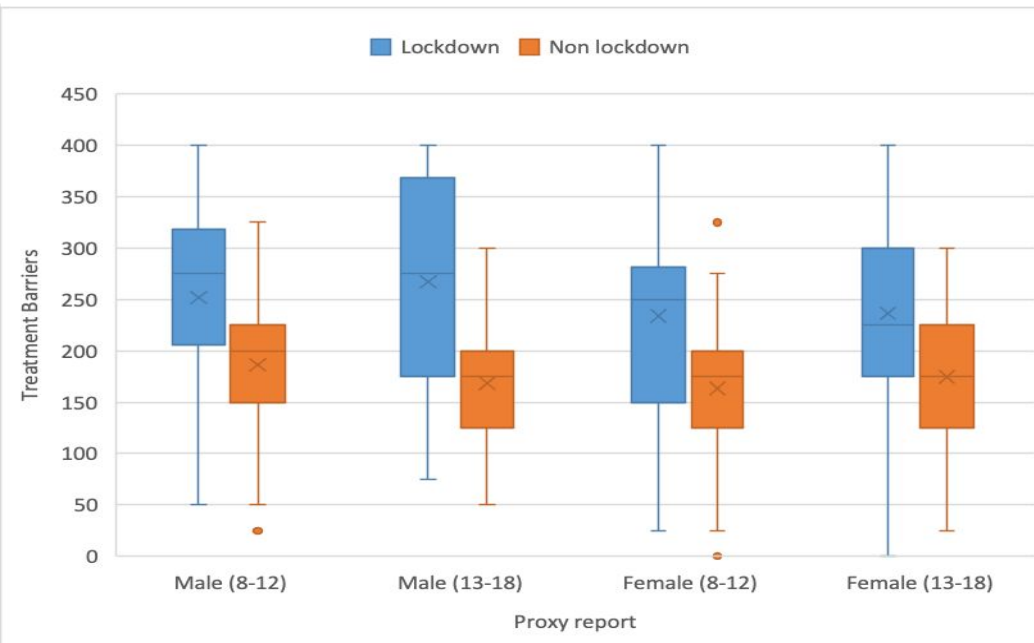
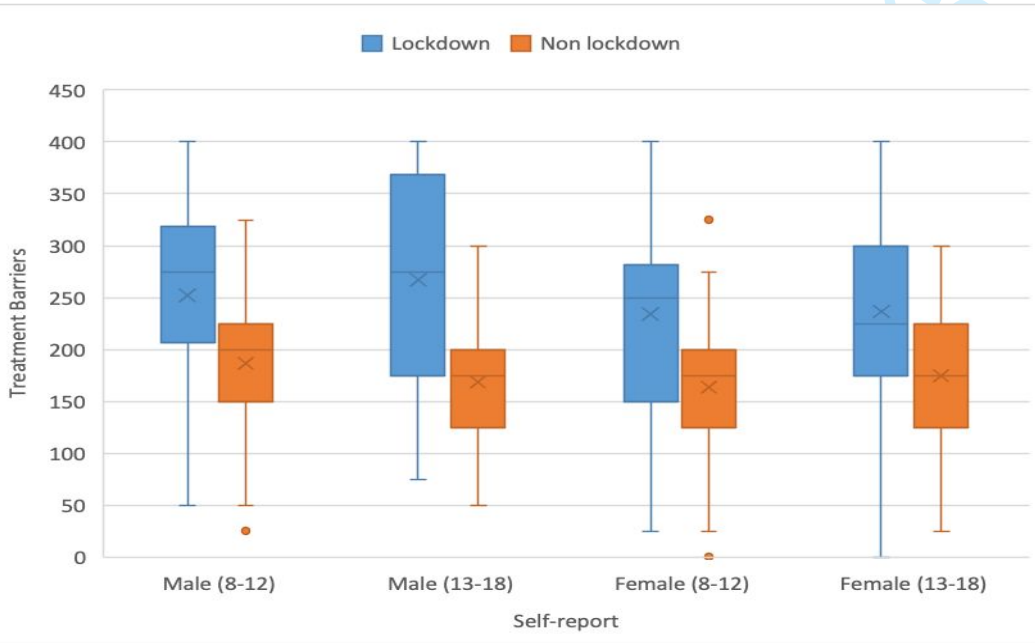
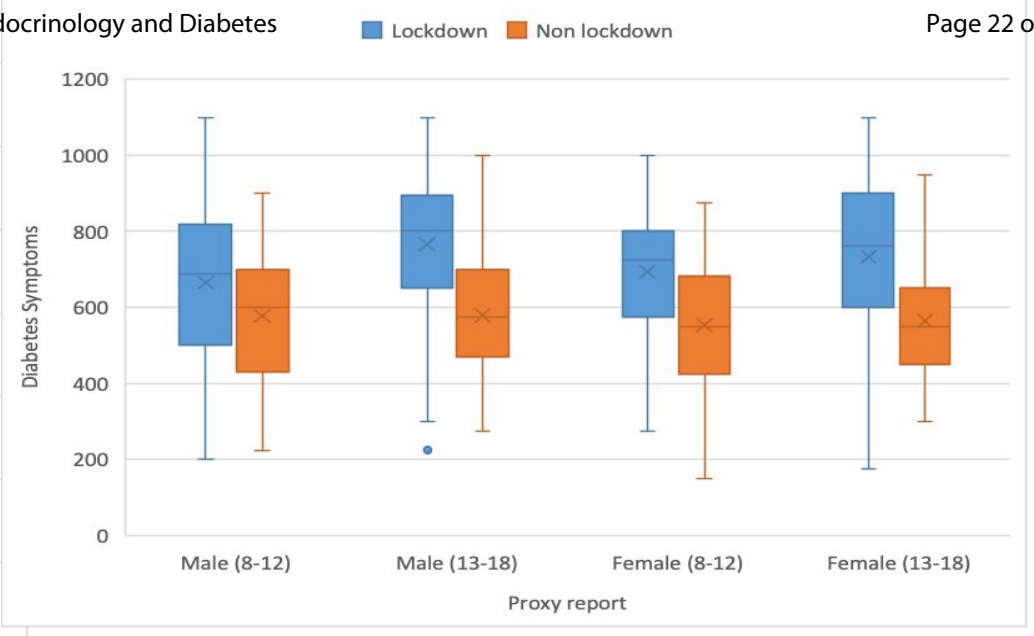
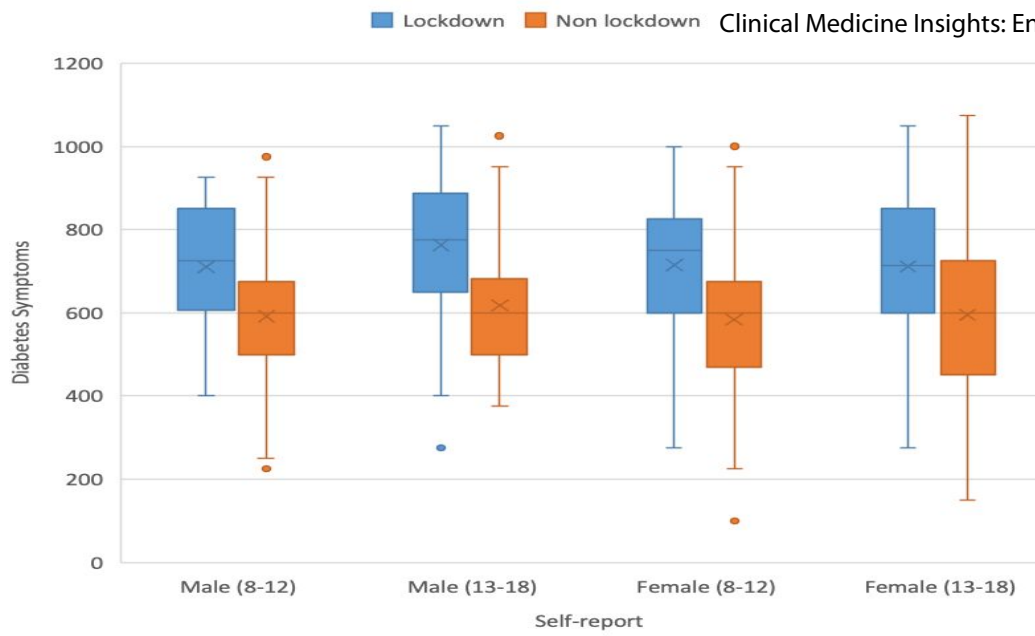
Table 1 – Demographics of participants and lifestyle changes in the study (Lockdown) and Control (Non-lockdown) groups

	Self-report					Proxy report				
	Lockdown		Non-lockdown		P-value	Lockdown		Non-lockdown		P-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
<i>Diabetes Symptoms</i>	728.2	176.5	598.5	172.5	< 0.001	727.8	193.8	569.0	159.0	< 0.001
<i>Treatment Barriers</i>	264.9	98.2	204.2	80.6	< 0.001	248.4	100.0	172.7	62.8	< 0.001
<i>Treatment Adherence</i>	469.0	128.7	383.4	117.6	< 0.001	450.8	133.3	390.5	112.5	< 0.001
<i>Worry</i>	189.0	83.1	138.2	71.1	< 0.001	172.5	93.3	95.4	60.0	< 0.001
<i>Communication</i>	215.2	88.8	166.8	72.8	< 0.001	216.6	85.5	179.3	67.2	< 0.001
<i>Total Aggregate</i>	1862.0	388.0	1491.0	366.0	< 0.001	1815.0	403.0	1407.0	302.0	< 0.001

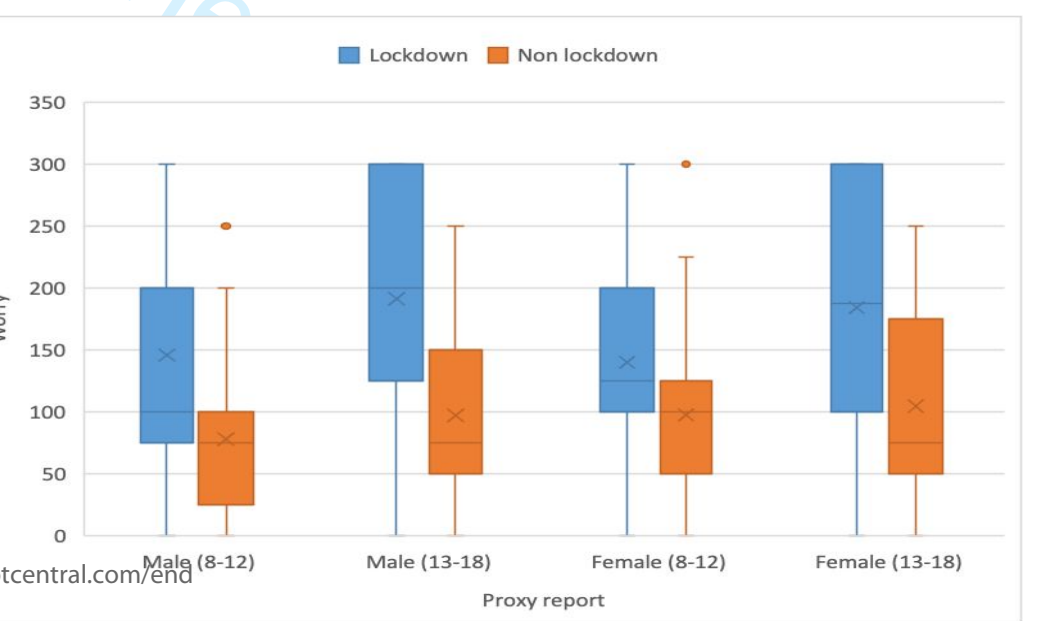
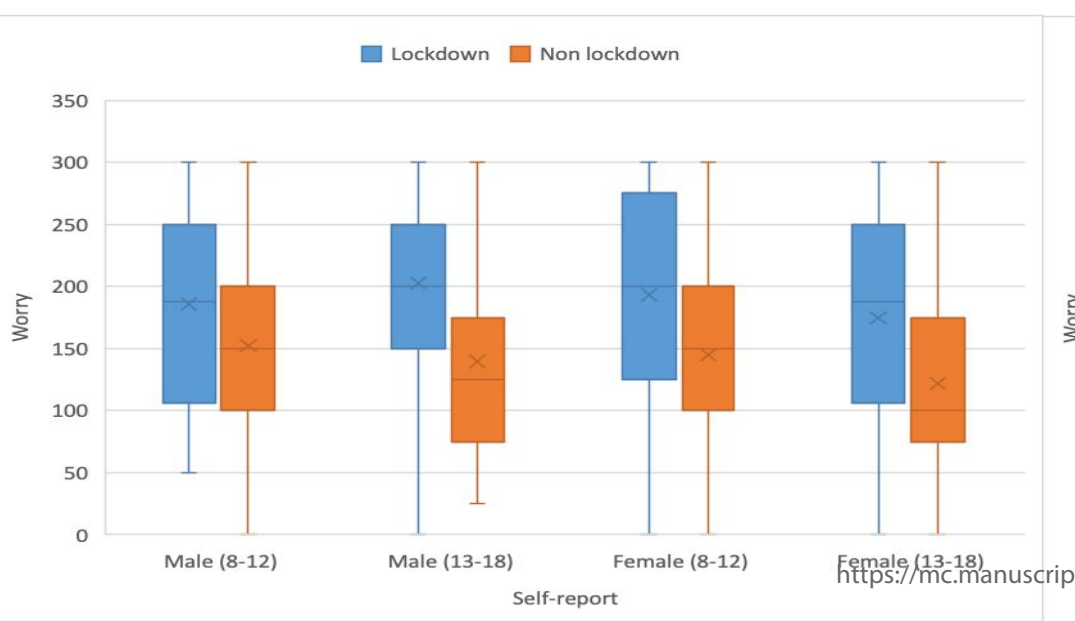
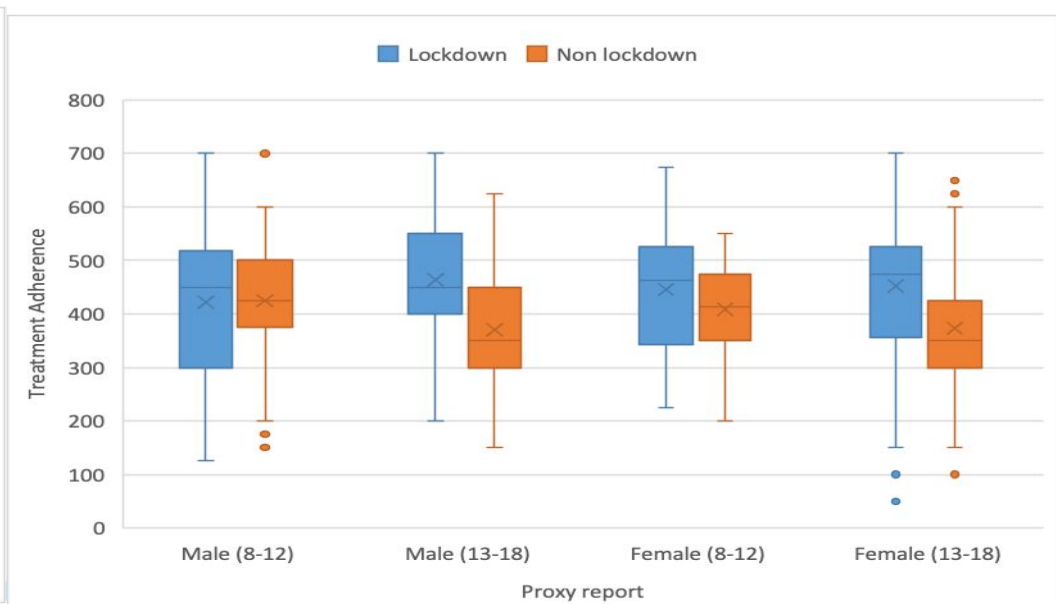
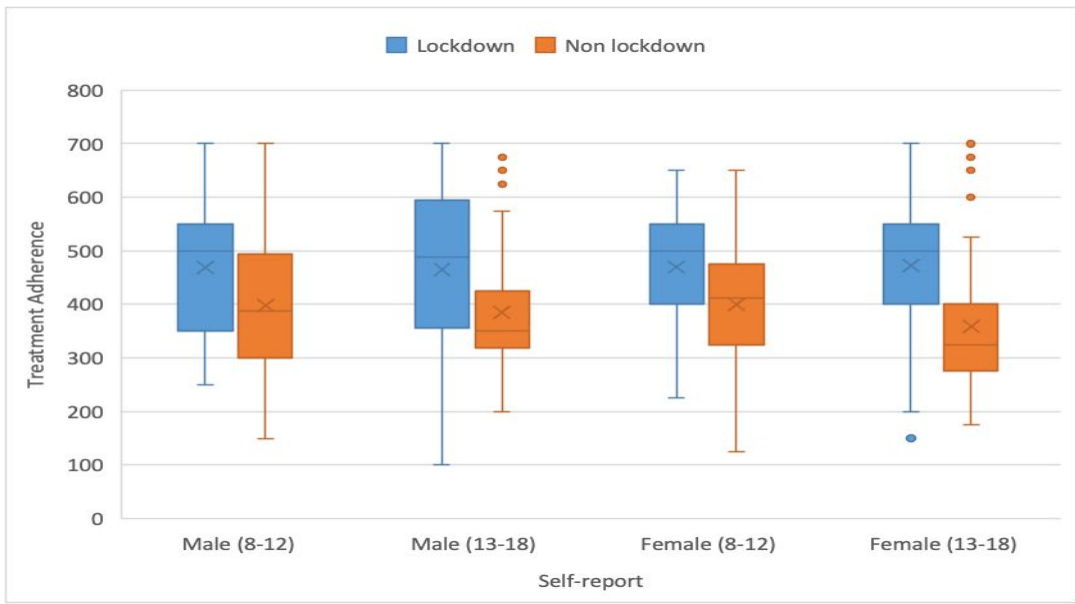
Table 2 -Self and Proxy quality of life reports during lockdown and non-lockdown periods

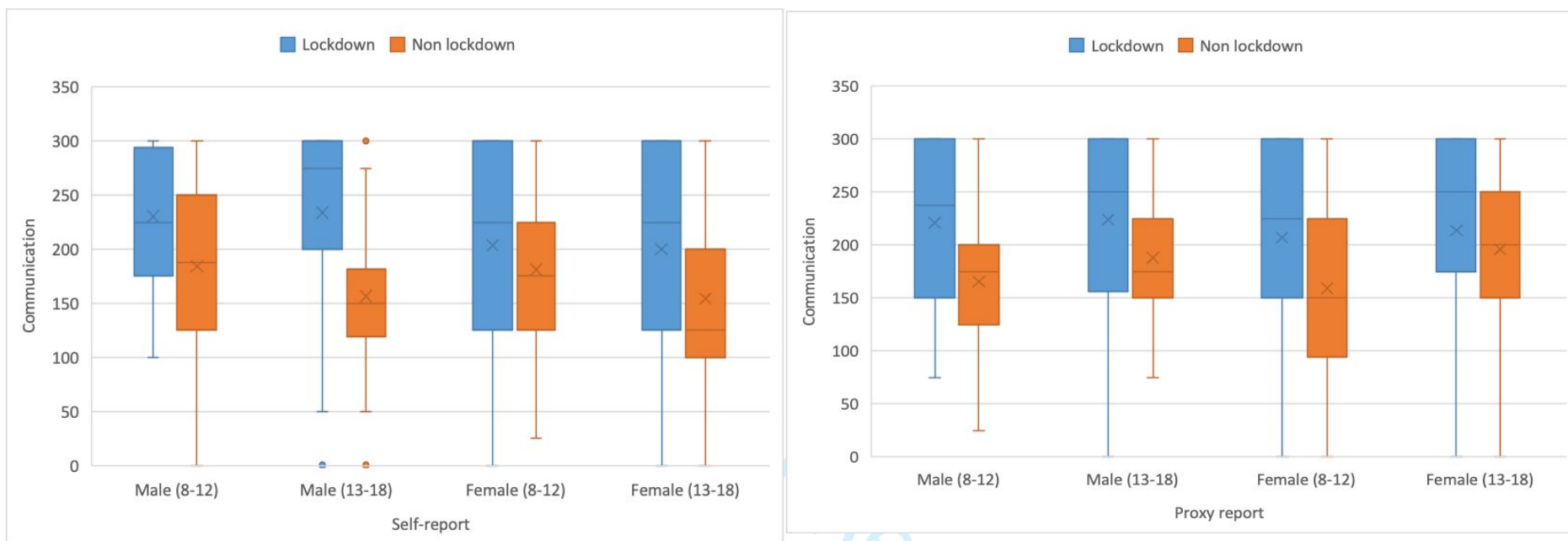
<i>Parameter</i>	Self report					Proxy report				
		B	P-value	95% CI for B			B	P-value	95% CI for B	
				Upper	Lower				Upper	Lower
<i>Total Aggregate</i>	Intercept	1217.9	<0.001	714.5	1721.4	Intercept	864.9	0.001	367.4	1362.5
	Lockdown	316.8	<0.001	213.1	420.5	Lockdown	279.3	<0.001	176.9	381.8
	Non-lockdown (ref.)	0.0	.	.	.	Non-lockdown (ref.)	0.0	.	.	.
<i>Diabetes Symptoms</i>	Intercept	634.5	<0.001	388.8	880.1	Intercept	429.7	0.001	181.2	678.2
	Lockdown	108.4	<0.001	57.8	158.9	Lockdown	135.8	<0.001	84.6	187.0
	Non-lockdown (ref.)	0.0	.	.	.	Non-lockdown (ref.)	0.0	.	.	.
<i>Treatment Barriers</i>	Intercept	95.2	0.142	-32.0	222.3	Intercept	44.7	0.437	-68.4	157.7
	Lockdown	33.2	0.013	7.0	59.4	Lockdown	27.9	0.019	4.6	51.2
	Non-lockdown (ref.)	0.0	.	.	.	Non-lockdown (ref.)	0.0	.	.	.
<i>Treatment Adherence</i>	Intercept	359.8	<0.001	185.4	534.2	Intercept	285.6	0.002	109.4	461.8
	Lockdown	101.5	<0.001	65.6	137.4	Lockdown	80.7	<0.001	44.4	117.0
	Non-lockdown (ref.)	0.0	.	.	.	Non-lockdown (ref.)	0.0	.	.	.
<i>Worry</i>	Intercept	80.1	0.139	-26.3	186.5	Intercept	14.7	0.762	-80.4	109.8
	Lockdown	18.6	0.096	-3.3	40.5	Lockdown	5.7	0.569	-13.9	25.3
	Non-lockdown (ref.)	0.0	.	.	.	Non-lockdown (ref.)	0.0	.	.	.
<i>Communication</i>	Intercept	48.3	0.396	-63.6	160.3	Intercept	92.7	0.075	-9.5	194.9
	Lockdown	55.2	<0.001	32.1	78.2	Lockdown	29.8	0.006	8.7	50.8
	Non-lockdown (ref.)	0	.	.	.	Non-lockdown (ref.)	0.0	.	.	.

Table 3 – Regression analyses of the overall changes in lifestyle against quality-of-life (QoL) scores in Self and Proxy reports



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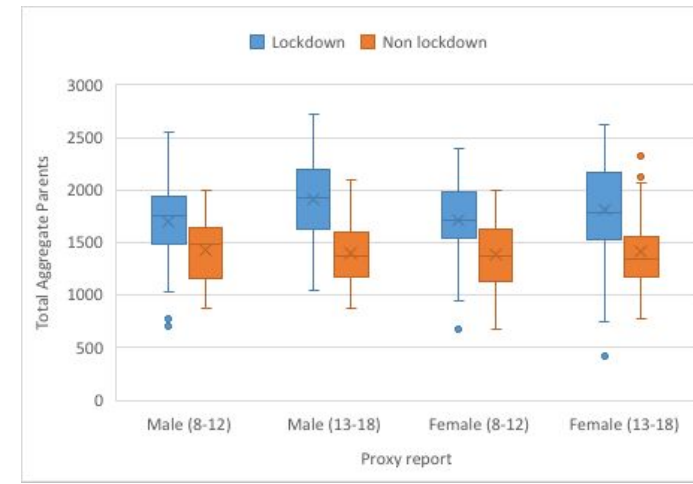
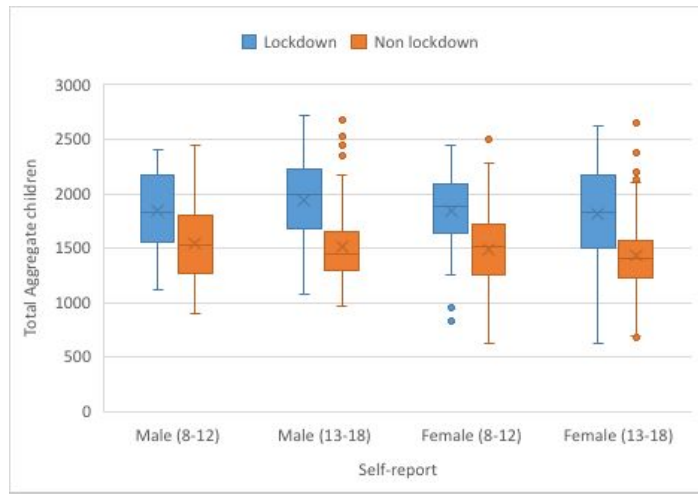


Figure 1a – Boxplots of QoL scores per age and gender

a Lockdown

b Non lockdown

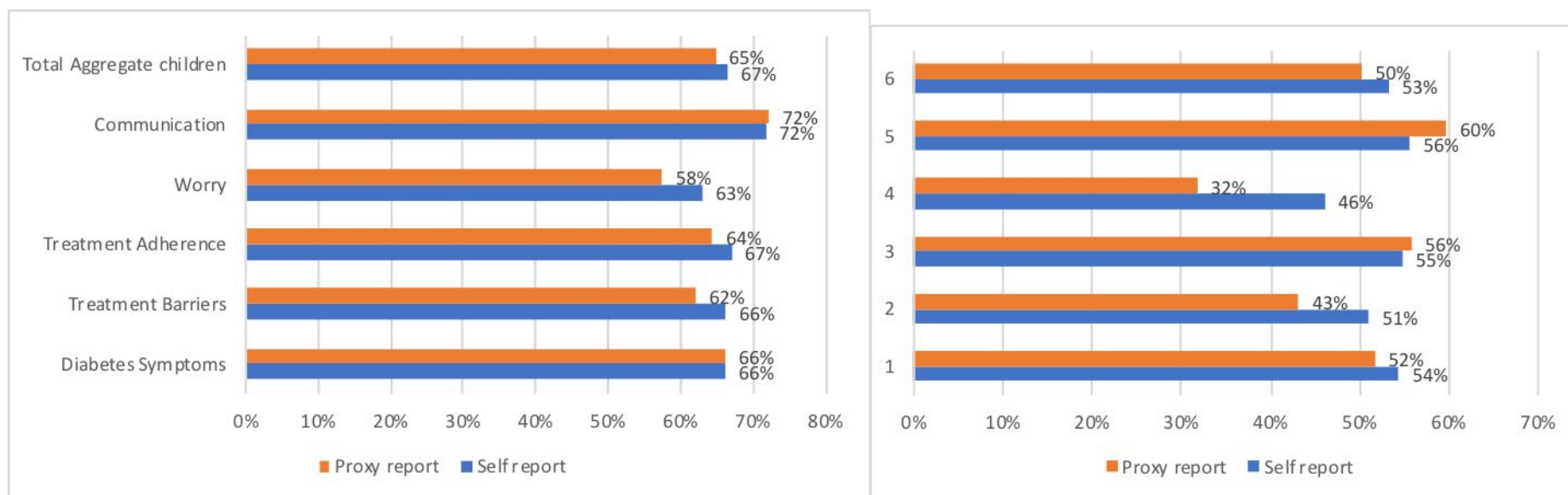


Figure 1b – Gap analysis

Figure 1 – a) Differences in QoL scores and b) Gap analysis, between self and proxy reports during lockdown and non-lockdown periods

Highlights

- Children and parents perceived overall better QoL during lockdown.
- Patients had better compliance with treatment.
- More family member involvement, as opposed to only mothers, was noted in the care of children living with type 1 diabetes during lockdown.

For Peer Review